THERMAL

INSULATION MANUAL

EHRET MAGNESIA MANUFACTURING CO.

VALLEY FORGE • PENNSYLVANIA

EHRET

INSULATION MANUAL

Including

PACKINGS • REFRACTORY CEMENTS

ASBESTOS FIBRES, TEXTILES and BUILDING MATERIALS

Mag
Air Cell
Wool Felt

Prepared and Published

by

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. IM 10

Printed in U. S. A.

THIS MANUAL has been prepared to assist the many men in business and industry who are interested in choosing, applying or using thermal insulations. The information is presented in data sheet form so that, with the new and revised data sheets which will be furnished from time to time, complete, up-to-date information will be contained in this one ready-reference volume.

The field of thermal insulations is so broad that a handbook alone can by no means be expected to supply the answers to all the problems that may arise. Ehret service to industry includes the assistance of their engineers, distributors and approved contractors on insulation surveys and tentative projects.

In preparing material for these data sheets, only authoritative sources have been used. Every effort has been made to ensure accuracy of the facts and figures presented, but no guarantee of any statement is implied.

Requests for data sheets or additional copies of this manual should be made to the Ehret Company or their representatives. Special folders containing selected data sheets are available on request.

Prices as well as additional information on the many Ehret industrial products that are not fully treated in this manual will be furnished on application.

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SECTION INDEX

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. IM 12

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TECHNICAL INFORMATION ON INSULATIONS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. TI 50

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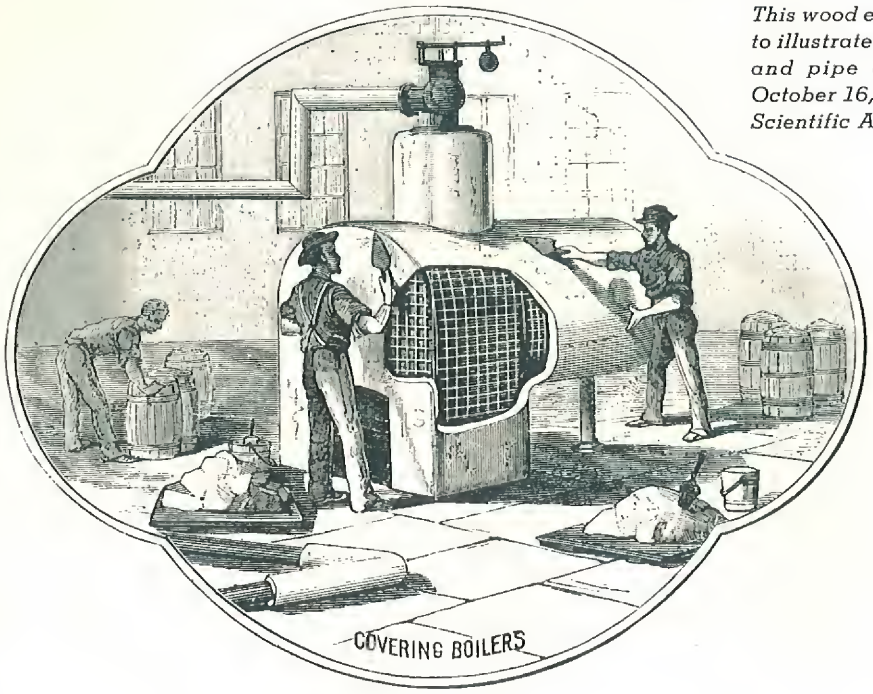

This wood engraving was used to illustrate an article on boiler and pipe coverings in the October 16, 1880 issue of the Scientific American

THERMAL INSULATIONS IN INDUSTRY . . .

In the latter part of the eighteenth century, when steam power was first being applied to industrial uses, there was apparently no effort made to conserve heat losses from bare pipes and equipment. In fact, there seemed to be little realization of the losses involved. Fuel was relatively cheap and the cost of the power obtained from the crude steam equipment was low as compared to the other sources of power that were in use at that time. It is not surprising that heat losses and thermal efficiencies, as such, were completely unknown.

Coverings on these early steam engines and pipes were first applied for the purpose of protecting workmen from burning themselves on the heated surfaces and to reduce temperatures in the engine rooms. Wrappings of rags and similar materials were put on steam lines, and boilers were daubed with clay.

The use of these covering materials produced evidence that fuel was being saved. Temperatures in cramped boiler rooms were lowered and the value of insulation began to be realized. As steam pressures and resulting steam temperatures increased, the "profit motive" became greater and the desirability of more and better insulation obvious. The higher temperatures emphasized the need for non-inflammable materials and experiments were carried on. Many materials in many combinations were tried during the first half of the 19th century.

From 1870 to 1890 gypsum plaster and various clays were mixed with binding materials such as sawdust, rope fibre, straw and hair. The resulting mixtures were applied in plastic form to boilers, pipes and equipment. Then different types of infusorial earth, mixed with water, molasses and other binders were used. Around 1880 a German product, made of diatomacious earth, called Kieselguhr, was applied as a plastic insulation on steam pipes with satisfactory results.

Various forms of sectional pipe coverings molded from mixtures of plaster of Paris with sawdust, vegetable fibres, sponge and later with asbestos fibres, were brought out during this period. The fact, now well known, that the insulating efficiency of a material is directly related to the size of the enclosed air spaces was just being recognized. Several forms of laminated coverings made from wrapped layers of felt or asbestos paper were introduced, and ground sponge in plaster of Paris was used as an insulating material at about this time. The sponge served both as a binder and as a means of forming the desirable minute air spaces in the molded coverings.

The initial insulating efficiencies of some of these early coverings were reasonably high, but they

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lacked mechanical strength and were subject to shrinking, charring and rapid general deterioration. Replacements were frequent, and where plaster of Paris coverings were used on iron or steel, rapid rusting of the metal resulted, especially in the presence of moisture.

During the early 1880's, Mr. Hiram N. Hanmore of Philadelphia conceived the idea of using carbonate of magnesia as an insulating material. What first prompted him to experiment with what was then but a drug store staple, is not definitely known, but a U. S. patent was granted to him on April 15, 1884, covering the use of carbonate of magnesia in conjunction with silk fibres as an insulation on vessels containing water and other fluids.

The first commercial application of magnesia insulation was made by Mr. Hanmore in the plant of the Franklin Sugar Refining Company of Philadelphia. The material was applied in plastic form and it gained immediate favor. Other installations of this remarkable new material soon followed, and a few years later molded magnesia pipe coverings and blocks were produced. For obvious reasons, asbestos fibres were soon used instead of silk fibres. Experimentation with the magnesia and asbestos fibres developed the fact that from 10% to 15% of fibre was ideal for the purpose. This proportion resulted in satisfactory mechanical strength with practically no decrease in the insulating efficiency of the magnesia. In 1887 the U. S. Navy specifications read "Magnesia Insulation material shall contain not less than 85% of Hydrated Carbonate of Magnesia."

The unusually high insulating efficiency of 85% Magnesia was not the only reason for its enthusiastic acceptance by engineers and maintenance men. It was easily handled, worked and applied; it was clean, light and inorganic in nature; it did not char, burn, shrink or loosen in service; it had no corrosive action on the metals to which it was applied; mechanical strength was satisfactory and it could be removed and reapplied with ease and no waste of the material. The fifty years that have passed since the invention of 85% Magnesia have proven its ability to maintain initial insulating characteristics.

At an early period of 85% Magnesia's history, it was found that when applied to heated surfaces carrying temperatures of more than 600° F., there was a tendency for the material to calcine on the inner surfaces. This calcination produced a thin film of magnesium oxide, which was even lighter and a more efficient insulating substance than the magnesium carbonate. However, magnesium oxide is not quite as strong mechanically as 85% magnesium, so the need developed for a protective inner layer of insulation which would stand higher temperatures and thus preserve all the unusual qualities of the 85% Magnesia.

Several years of development produced high temperature insulations of diatomacious earth which functioned satisfactorily at temperatures up to 2000° F. Since these insulations were not quite as efficient as 85% Magnesia, the applied thicknesses were only great enough to assure an inter-face temperature of not over 600° F. These high temperature insulations are now produced in pipe covering, block and cement forms, the same as 85% Magnesia, and are normally used as an inner layer to protect the 85% Magnesia from calcination.

The best of these high temperature insulations usually consist of pre-calcined diatomacious earths, suitably graded asbestos fibres and certain binding agents. A low percent of shrinkage at high temperatures is a most important requisite of this inner layer insulation.

The development and improvement of thermal insulations for use on steam generation, distribution and power equipment has had some highly important effects in a number of other industrial fields. For example, there are today many process industries that could not function without the insulations that hold critical process temperatures within close tolerances. In such cases the value of the heat saved is frequently secondary in importance to the accuracy of temperature maintenance.

The enormous amount of experimentation and research that has been done by the manufacturers of insulations as well as by engineering societies, technical schools, insulation engineers and various research organizations, has resulted in a great variety of new insulating materials and a wealth of technical and scientific insulation data. The new insulating products that have been developed are, in practically every case, special materials for special purposes. None of these new insulations has taken the place of 85% Magnesia, or of the combination of diatomacious earth materials with 85% Magnesia, for general industrial use.

Thermal insulations and their proper use are of ever increasing importance to business and industry. With fuel, power and labor costs tending steadily upwards, small economies become significant. As boiler and process temperatures continue to increase and refrigeration temperatures decrease, insulations are relied upon to minimize losses.

A principal function of the manufacturers and distributors of insulating materials is to assist in choosing insulation best suited to the need. Sections, sheets, blocks, bricks, plastics, cements, blankets, papers, fabrics, fills, batts and aggregates are available in a variety of materials, sizes and shapes for use with temperatures ranging from 3500° F. down to low sub-zero. The insulation industry provides dependable information concerning materials, thicknesses and methods of application for both general and particular service conditions.

INSULATION PRINCIPLES AND PRACTICE . . .

When a heated metal surface such as a steam pipe is surrounded by air at normal room temperature, heat is lost from the pipe. The film of air which is actually in contact with the pipe surface is quickly raised to approximately steam temperature, the heated air rises and more air at room temperature is drawn in to take its place. The convection currents in the air result in rapid heat losses from the pipe with the room temperature tending to rise steadily and the steam temperature tending steadily to fall. If the pipe is exposed to wind conditions, the heat losses are greatly increased.

If this same steam pipe is covered with a layer of pipe insulation, the temperature at the inner surface of the insulation will approximate that of the steam and the temperature of the outer surface of the insulation, that of the surrounding air. Convection currents are relatively negligible and room temperature is not appreciably affected. The flow of heat from steam to air is greatly reduced and heat losses are minimized.

From the above example it is evident that the amount of heat saved bears a close relation to the thermal conductivity of the insulating material used, and the greater the thickness, the greater the insulating effect.

The thermal conductivity of a material is a characteristic of the material itself and is not a function of size or thickness. It is numerically expressed as a factor, K, which represents the quantity of heat, in BTUs, that flows in unit time through unit area and unit thickness at unit temperature difference between faces of the material. The term "thermal conductivity" applies to a single material and not to a combination of layers of different materials.

This factor K varies widely for different materials, metals generally having high K values and insulating materials such as cork, felt and 85% Magnesia having low K values. The K value of a material is not constant, but varies with a change in mean temperature of the material itself.

Economics of Thermal Insulations

Thermal insulations should be applied where the advantages to be gained more than compensate for the cost involved. Fortunately, both cost and advantages of tentative insulation projects can be easily and accurately estimated beforehand. The findings of such insulation studies can be quite definite as to recommendations of materials, thicknesses, costs and other factors.

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Efficiencies

The efficiency of an insulation application is based on the ratio of the heat (or power) saved to the heat (or power) that would be lost from the uninsulated surfaces. The term "Efficiency" is not applied to insulating materials as substances but to specific applications of specific materials. This relationship is expressed, in percentage, by means of the following formula:

$$\text{Efficiency } (\%) = \frac{\text{bare loss} - \text{insulated loss}}{\text{bare loss}} \times 100$$

The heat losses from both bare and insulated surfaces are usually expressed in BTUs.

Example: consider an application of Ehret's Enduro Block 4" thick on a flat surface, with a temperature difference between the inner and outer block surfaces of 700° F. The table of efficiencies and heat losses for Enduro Block on Sheet No. 118 shows the unit bare surface loss as 6.040 BTUs and the unit loss from the insulation surface is 0.145 BTUs.

$$\text{Efficiency} = \frac{6.040 - 0.145}{6.040} \times 100 = 97.59\%.$$

In using the above formula, the efficiency will figure out the same no matter whether the BTU values are based on unit loss or total loss, as long as each calculation is on the same basis. This also holds true for the time unit involved.

Efficiencies and heat losses of insulating materials in different thicknesses are given in tabular form on Ehret data sheets devoted to the various materials. By using these tables in conjunction with other tabular material in the Useful Data section of the Ehret Insulation Manual, studies of insulation projects can usually be made with comparative ease.

The following examples will illustrate the use of tabular data in the solution of standard insulation problems.

EXAMPLE "A"

An 8-inch pipe line, indoors, carrying steam at 470 degrees F. is 450 feet long. This line is in service 16 hours a day for 300 days a year. The boiler that supplies steam to this line has an overall efficiency of 72%. The fuel used is coal containing 13,000 BTUs per pound and costs $5.00 per ton, fired. Average room temperature is 70 degrees F.

Problem A-1

What pipe covering material should be applied to this line and in what thickness to provide satisfactory economy?

Solution—

The table of recommended thickness (Sheet No. 112) suggests the use of Double Standard Thick 85% Magnesia. General practice has shown this thickness to give satisfactory results for ordinary operating conditions.

Problem A-2

What is the heat saving effected by the recommended insulation?

Solution—

Referring to the table of heat losses on Sheet No. 108 it is seen that:—

The heat loss from the bare pipe is. . . . . 3.860 BTUs
The heat loss through the insulation is. . .228 BTUs

The heat saved is the difference. . . . . 3.632 BTUs

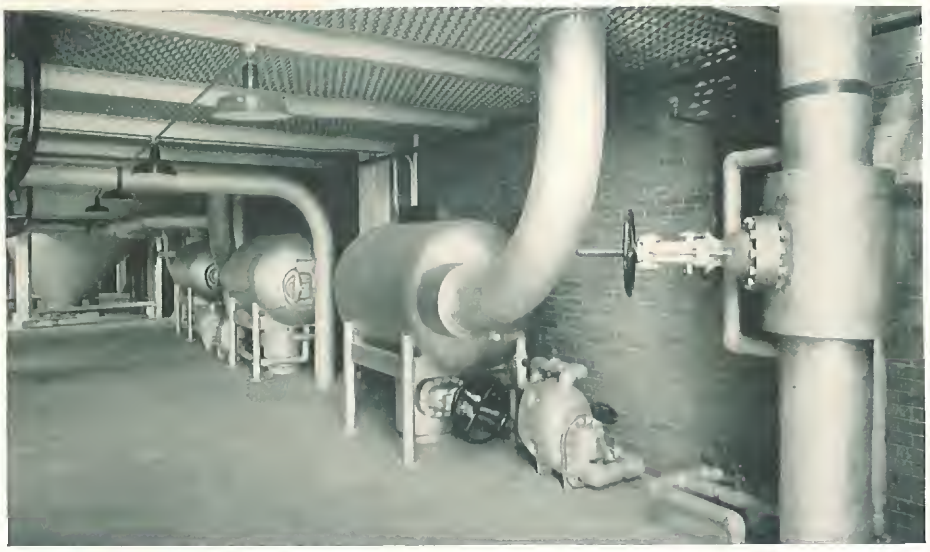
The above BTU values are per square foot of outer pipe surface per hour per degree of temperature difference between pipe and air; to find the total for the entire pipe line and the period of use is a matter of multiplication, as follows:—

On Sheet No. 704 it is seen that an 8" pipe has 2.262 square feet of outer surface per lineal foot. The number of working hours per year is 300 days multiplied by 16 hours per day, or a total of 4800 hours. The temperature difference between pipe and air is 470 degrees F. less 70 degrees F., or 400 degrees F. Therefore, the total BTUs of heat in the steam which would be saved is:—

$3.632 \times 450 \times 2.262 \times 4800 \times 400$ equals approximately 7,100,000,000 BTUs per year.

The degree of skill and care with which insulations are applied is just as important as the type and quality of materials used.

These Ehret-insulated tracifiers and feed-water heater are in a General Motors plant. Neat, workmanlike finish indicates the care taken with the entire insulation application.



Problem A-3

What are the monetary savings per working year?

Solution—

Since the boiler efficiency is 72%, there is considerable heat content in the fuel fired which does not enter the steam. Therefore, the BTUs of fuel saved is calculated by dividing the heat savings by .72 and this comes to 9,860,000,000.

Dividing by the heat content of the coal, 13,000 BTUs per pound, gives the number of pounds of coal saved. Dividing again by 2000—gives 379 tons of coal saved. At the cost of $5.00 per ton fired the estimated insulating saving would be $1,895.00.

By referring to the heat loss and efficiency table it will be seen that the efficiency of the insulation is 94.10%. Then $\frac{100}{94.10} \times \$1896 = \$2014.88$ which represents the value of the heat that would be lost from the bare pipe.

Problem A-4

What would the effect be on heat losses if the pipe line were exposed to wind conditions?

Solution—

Referring to the table of the Effect of Wind Velocity, appearing on the back of Sheet No. 703, it will be seen that still air losses are greatly increased under wind conditions. Consequently, where insulated surfaces are to be exposed to wind, thicknesses should be increased.

EXAMPLE "B"

A 6" pipe line supplies a turbine with superheated steam, at a total temperature of 770 degrees F. This line is insulated with an inner layer of Ehret's Enduro, 1½" thick and an outer layer of Ehret's 85% Magnesia, 2½" thick. The average room temperature is 70 degrees F.

Problem B-1

What is the heat saved per lineal foot of pipe per hour?

Solution—

Referring to the tables of heat losses on Sheet No. 116:

The heat loss from the bare pipe is. . . . . 6.490 BTUs
The heat loss through the insulation is. . .209 BTUs
The heat saved is the difference, or. . . . 6.281 BTUs

From Sheet No. 704 it is seen that there is 1.736 square feet of outer surface to one lineal foot of 6" pipe. The temperature difference is 770 degrees F., less 70 degrees F., or 700 degrees F.

Therefore, $6.281 \times 1.736 \times 700$ equals 7,633 BTUs and is the heat in the steam saved per lineal foot per hour.

Problem B-2

What is the monetary saving per lineal foot per working year of 4800 hours, assuming boiler efficiency of 72%, heat content of coal at 13,000 BTUs per pound, and cost of coal fired, at $5.00 per ton.

Solution—

$\frac{7633 \times 4800}{.72 \times 13000 \times 2000} \times \$5.00$ equals $9.79 as the monetary saving per lineal foot per working year of 4800 hours.

Problem B-3

What would be the monetary saving if other types of fuel are used, such as fuel oil or gas?

Solution—

The calculation is exactly the same as shown in the solution for Problem 2, except that the BTU content of the fuel should be substituted for that of coal, and the pounds of oil or cubic feet of gas be substituted for the weight per ton of coal. Then applying the proper cost of the fuel, the final monetary saving is obtained.

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EXAMPLE "C"

Gas fired process equipment, having an operating temperature of 1600 degrees F. is to be insulated on the outside of 9" thick fire brick walls with Ehret's Enduro blocks, 3 inches thick.

Problem C-1

What is the heat saving in BTUs per square foot of wall surface per operating year of 4800 hours?

Solution—

Referring to the back of Sheet No. 119 it is seen that the heat loss per square foot per hour from the uninsulated surface is 1150 BTUs and through the insulation it is 275 BTUs. The difference, or 875 BTUs, is the heat saving per square foot per hour. Multiplying this result by 4800 hours, gives 4,200,000 as the total BTUs saved per square foot per year of 4800 hours.

EXAMPLE "D"

A 36" diameter exhaust header from Diesel engines, carrying gas at an average temperature of 1200 degrees F., must be insulated to protect workmen from being burned and to prevent high room temperature.

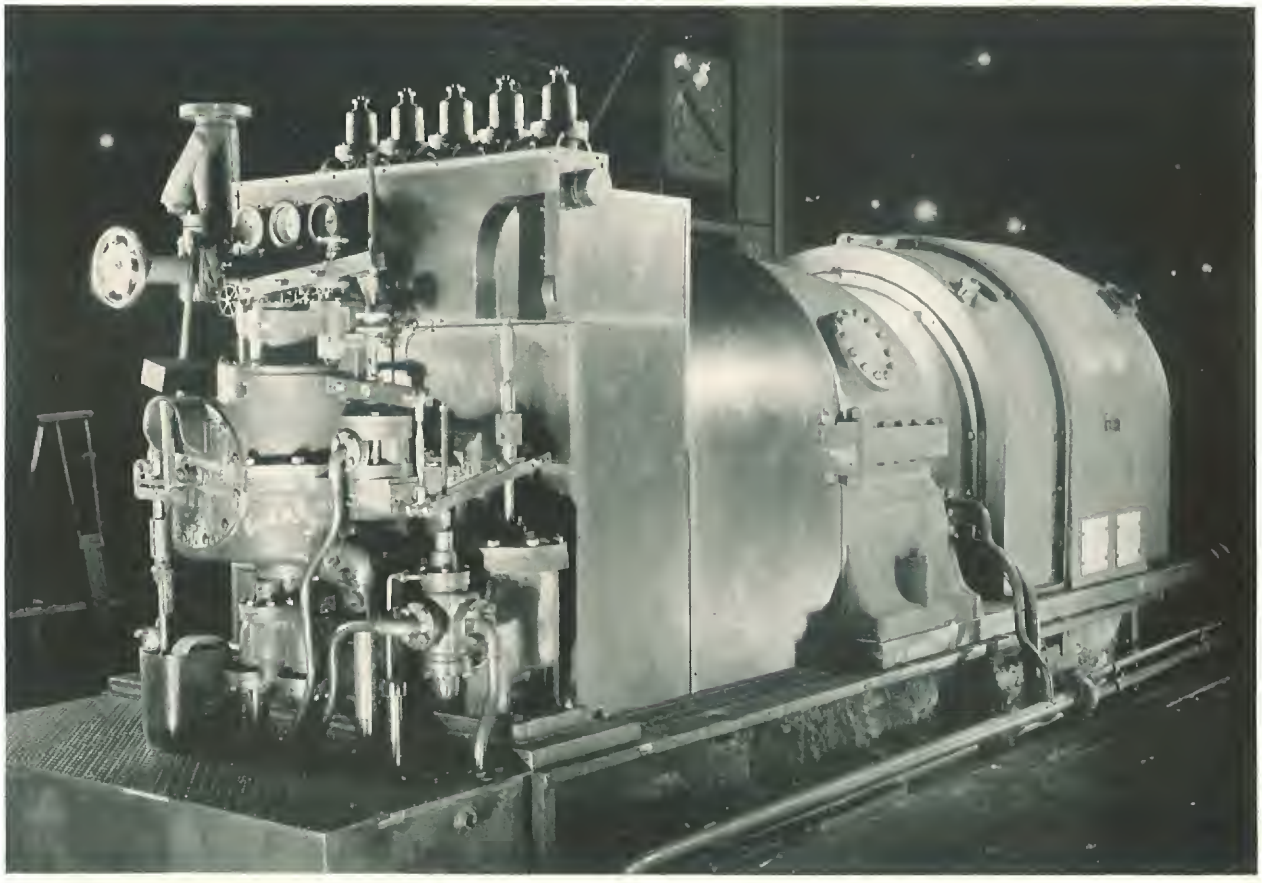
Problem D-1

What type of protective covering and thickness of material should be used?

Solution—

From the temperature involved (1200° F.) the use of Ehret's Enduro is indicated. However, before any insulating material is definitely decided on, several factors other than operating temperature should be considered.

A study of the particular conditions and requirements will doubtlessly raise questions such as: What is the permissible outer-surface temperature?—How much ventilation has been provided for the room containing this equipment?—To what conditions of vibration will the insulated surfaces be subjected?—Will certain parts of the insulated equipment require occasional removal of the insulation for repairs or servicing?—What are the construction limitations?—Questions such as these should be fully considered before final choice of materials, thicknesses and application methods is made.



It is particularly necessary that steam fed to turbines be free from condensate, so this neatly-jacketed turbine is protected with Ehret insulations. It is an Allis Chalmers impluse reaction type turbine developing 1500 KW at 3600 r.p.m.

HEAT LOSS FORMULAE

Generally speaking, the transmission of heat through an insulating material varies directly as the difference in temperature between the inner and outer surfaces of the material, and inversely as the resistance of the insulation to the transfer of heat. This resistance is a function of the thermal conductivity of the material and its applied thickness. That is, $R = \frac{X}{K}$, where R is the resistance, X is the thickness of the insulation and K is its thermal conductivity.

The amount of heat transmitted through a given insulation of given thickness in a given period of time will vary with the shape and position of the insulated surfaces as well as with exposure to wind conditions. Usual practice bases heat loss calculations on still, dry air conditions. If actual conditions vary appreciably from the assumed conditions, the necessary corrections should be considered in the final calculations.

In the formulae given, the following terms are used:

U = HEAT LOSS in BTUs per square foot of outer insulation surface, per hour.

H = HEAT LOSS in BTUs per square foot of pipe surface per hour.

T_p = TEMPERATURE of inner (or pipe) surface in degrees F.

T_o = TEMPERATURE of outer (or canvas) surface in degrees F.

T_a = TEMPERATURE of surrounding air in degrees F.

X, X_1, X_2, X_3, etc. = ACTUAL THICKNESSES of insulation layers, in inches.

K, K_1, K_2, K_3, etc. = THERMAL CONDUCTIVITIES of respective layers.

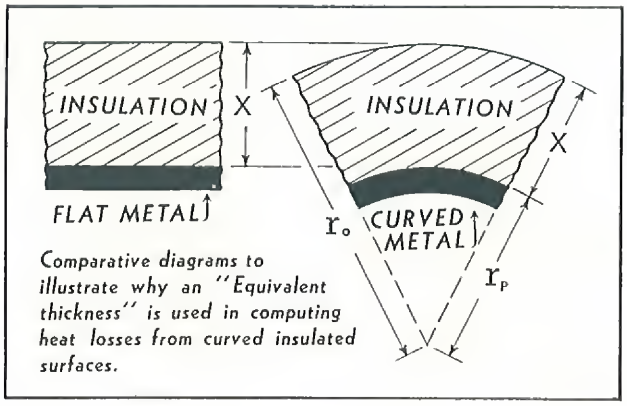
r_p = RADIUS of inner (or pipe) surface, in inches.

r_o = RADIUS of outer (or canvas) surface, in inches.

r_1, r_2, r_3, etc. = Radii of outer surfaces of respective layers, in inches.

(For a single layer pipe insulation $r_o = r_1$ and for a double layer pipe insulation, $r_o = r_2$.)

D = OUTSIDE DIAMETER of the insulation on pipe or curved surfaces, in inches.



Comparative diagrams to illustrate why an "Equivalent thickness" is used in computing heat losses from curved insulated surfaces.

FLAT SURFACES

To calculate the heat losses from insulated flat surfaces, the following formulae will serve in nearly all cases.

For one material $U = \frac{T_p - T_o}{\frac{X_1}{K_1}}$

For two materials $U = \frac{T_p - T_o}{\frac{X_1}{K_1} + \frac{X_2}{K_2}}$

In the above formulae, the temperature of the outer surface (T_o) can be either carefully estimated or actually measured.

CURVED SURFACES

When computing the heat losses from curved surfaces, such as pipes, the resistance is not based on the actual thickness of the insulation but on an "equivalent thickness." The accompanying diagram shows sections through two insulated metal surfaces of unit outside area, one flat and one curved. Although the thickness of insulation on each area is the same, the total *volume* of insulation as well as the external *surface area* of the insulation is different. As a consequence, where the heat loss is to be based on the outer surface, the equivalent thickness is equal to $r_o \log_e \frac{r_o}{r_p}$. In case the heat loss is to be based on the *pipe* surface, the equivalent thickness is equal to $r_p \log_e \frac{r_o}{r_p}$

Using these "equivalent thicknesses," it can be

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seen that the formulae for heat losses from curved surfaces are as follows:

$$\text{one material}\ldots U=\frac{T_p-T_o}{\frac{r_o \log_e r_o/r_p}{K}}$$

$$\text{two materials}\ldots U=\frac{T_p-T_o}{\frac{r_o \log_e r_1/r_p}{K_1}+\frac{r_o \log_e r_o/r_1}{K_2}}$$

and

$$\text{one material}\ldots H=\frac{T_p-T_o}{\frac{r_p \log_e r_o/r_p}{K}}$$

$$\text{two materials}\ldots H=\frac{T_p-T_o}{\frac{r_p \log_e r_1/r_p}{K_1}+\frac{r_p \log_e r_o/r_1}{K_2}}$$

SURFACE TEMPERATURES

In solving the above formulae, the temperature of the outside surface of the insulation must be approximated or measured. The *air* temperature means little if the various surface factors are not known, and these factors vary widely, depending on individual conditions.

In case the actual temperature of the outside surface of the insulation is not obtainable, a good procedure is to assume an approximate outside temperature (T_o) and solve the heat loss formula for U. Then substitute the value obtained for the heat loss in the following formula along with the air temperature, and solve.

$$T_o=\frac{272.5\times U}{U+\frac{564}{D^{0.19}}}+T_a$$

This computed value of T_o should be compared to the value of T_o that was assumed in the heat loss formula. If the error in the first assumption was relatively large, the computed T_o should be used as a guide to correct the assumed T_o, and the formulae re-solved until accuracy is satisfactory.

Furnace wall covered with Ehret's Enduro Block, pointed with Enduro Cement

On insulated flat surfaces, heat losses per unit area of outer surface are the same as the inner surface unit losses. Consequently, the above formula for outer curved surface temperature can be simplified for flat surfaces to read:

$$T_o\ (\text{approx.})=\frac{272.5\times U}{U+295}+T_a$$

The fact that outer-insulation (canvas) temperatures are likely to be but slightly higher than air temperatures, is apt to be misleading as to the magnitude of the actual heat losses taking place. The cooling action of even light air currents results in many times the theoretical losses that are based on ideal still air conditions.

HEAT LOSS UNITS

The heat losses as computed in the above formulae are based on BTUs per square foot of surface per hour for the total temperature difference between heated metal and air. If heat losses are desired on the basis of BTUs per square foot of surface per hour, *per degree of temperature difference*, merely divide the total BTUs by the number of degrees of temperature difference.

CONDUCTIVITIES

Thermal conductivities of materials as used in the above formulae should be based on the mean temperature of the layer of insulation considered. Actually conductivities of nearly all materials vary with the temperature. As the conductivities must be chosen before the formulae are solved, it is necessary to assume approximate inter-face temperatures in order to arrive at mean temperatures. Where a great degree of accuracy is desired, these assumed inter-face temperatures and the resulting conductivities should be checked by calculating the inter-face temperature.

If the temperatures, as calculated, do not agree with those assumed, then choose a new conductivity value for that originally used and solve the formula again. This process should be continued until the desired degree of accuracy is reached. The temperature-drops through the various layers in multiple-layer insulations can be calculated by dividing the total temperature difference between the inner surface of the inner layer and the outer surface of the outer layer by the sum of all resistances, and then multiplying the result by the resistance of each layer. If the temperature drop of each layer be subtracted successively from the temperature of the inner surface of each layer, all inter-face temperatures will be found. In other words, multiplying the BTU loss per square foot, per hour by the resistance of each layer will give the temperature drop through each layer.

Should these flanges and fittings be insulated? If so, with what materials and in what thicknesses? Ehret Surveys regularly answer such questions for those who wish to obtain full insulation economy.

EHRET INSULATION SURVEYS

To obtain full value, insulation applications should be regularly inspected and maintained in good service condition. Maintenance includes the repair of broken or damaged surfaces; painting; moisture or weatherproofing; tightening of bands, wires and jackets.

Service inspections and ordinary maintenance are not, however, a guarantee of full insulation economy. In most cases there are other factors that necessitate more than superficial examination and treatment.

One of the trends in industry over the years has been to increase steam pressures and process temperatures on existing piping and equipment. Unless original insulation applications were made thicker than necessary when installed, thermal efficiencies at the higher temperatures are apt to be uneconomically low. Heat losses due to these conditions can reach major proportions without giving any warning of their existence to those who make routine maintenance inspections.

There are other causes of loss in insulating efficiency which seldom present external evidence. An apparently well-maintained jacket may contain insulating materials that have loosened, shrunk, deteriorated or suffered from moisture, water, chemical fumes, vibration or temperatures high enough to permanently damage the material. The outer appearance of insulating coverings is seldom a sound basis for judging the efficiency of the materials within. Technical surveys should be made from time to time by competent insulation specialists to determine the existence of any conditions that warrant correction. Frequently, by taking advantage of the results of such studies, savings many times greater than the cost of changes involved are made.

The Ehret Company and its approved insulation contractors maintain an insulation survey service for the users of thermal insulations. Because of the variety of conditions under which industrial heat and cold insulations are used, there is no set procedure that can be applied to all cases. However, the following points are among those usually considered:

1. Are there any surfaces on piping (such as flanges, fittings, etc.) or equipment that have not been, but should be, insulated?
2. What materials should be applied to surfaces that should be insulated?
3. Are the insulating materials now in use of the proper type?
4. Are thicknesses of existing materials adequate to provide maximum economy under present operating conditions?
5. What additional insulations, and in what thicknesses, should be added to existing insulations?
6. If the studies indicate a need for changes or additions to existing insulations, what will be the costs and the resulting savings?

Ehret Insulation Surveys are not difficult to make from either your standpoint or ours. On request, we will inspect your insulations, piping and equipment; obtain necessary data; make an analysis; and submit a report to you. If the results show that your present insulations are economically adequate, you will have the assurance of knowing it. If the need for additional insulations is indicated, detailed recommendations as well as estimates of costs and savings will be presented for your consideration. In either case you will not be obligated in any way.

On the reverse of this sheet are reproductions of two forms used in an Ehret Insulation Survey and Analysis. The information shown on these forms is typical of the surveys we make for users of industrial insulations. Ehret engineers and approved contractors are specialists in reducing fuel and power losses, and their experience in the solution of insulation problems is available to you.

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EHRET
INSULATIONS

INSULATION SURVEY

Form No. TI-01.

For Blank Cotton Mill By Ehret Magnesia Manufacturing Co. Date 3/14/39 Sheet No. 2

Item Number	SURFACES UNDER CONSIDERATION (Location, description, sizes, etc.)	Operating Temps. (or Steam Press.)	Ambient Temps. (Deg. F.)	PRESENT INSULATION Description	PRESENT INSULATION Condition	Service Hours per year
7	Top of an H.R.T. Boiler (100 sq. ft. area)	350° F.	90°	4" of Red Brick	No insulation value	8600
8	Steam Header - 10" diameter 10 ft. long	350° F.	90°	None	--	8600
9	Steam line to slashers from header to P.R. Valve - 4" diameter and 125 ft. long	350° F.	75°	85% Magnesia, Standard thick	Satisfactory	8600
10	Sizing tanks - (5) 4 ft. diameter by 4 ft. high	200° F.	70°	None	--	4200
11	Heating line - 10" diameter 75 ft. long	250° F.	70°	Four Ply Air Cell	Poor	5040

Type of Fuel Coal
Unit Cost of Fuel $4.50 per ton
BTU Content of Fuel 13,000 BTU's/lb.
Boiler Efficiency 72%
Unit Cost of Steam (or Heat) $0.42 per M lbs. (including $2.00 per ton for cost of firing)
Wind Conditions 10 mi. average on outdoor piping
Other Data

EHRET MAGNESIA MANUFACTURING COMPANY • VALLEY FORGE • PENNA.

INSULATION ANALYSIS AND RECOMMENDATIONS

Form No. TI-02.

For Blank Cotton Mill By Ehret Magnesia Manufacturing Co. Date 3/14/39 Sheet No. 4

Item Number	RECOMMENDED CHANGES (Materials, Thicknesses, etc.)	Heat Losses in Dollars per Year: Present Conditions	Heat Losses in Dollars per Year: After Changes	Gross Savings per year over existing conditions	Cost of Changes (approximate): Total	Cost of Changes (approximate): Per Year*	Net Savings per year in Dollars	Time Required for savings to pay for changes: Years Mo.	Net Savings per year after savings have paid for changes: Dollars	Net Savings per year after savings have paid for changes: % Return on Invest.
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5 (Col. 3 minus 4)	Col. 6	Col. 7	Col. 8 (Col. 5 minus 7)	Col. 9 (Col. 6 div. by 5)	Col. 10	Col. 11
7	Remove brick and apply 85% Magnesia Block 2" thick. Protect with No. 150 Asbestos Cement, hard finish, 1" thick.	211.14	13.87	197.27	72.00	7.20	190.07	--- 4 1/2	197.27	274%
8	Cover with Double Standard thick 85% Magnesia.	64.26	4.50	59.76	21.20	2.12	57.64	--- 4 1/2	59.76	295%
9	Increase to Double Standard thick 85% Magnesia.	44.94	22.05	22.89	90.00	9.00	13.89	3 - 11	22.89	25%
10	Cover with Valculite cement 1" thick and canvas jacket.	31.50	5.25	26.25	25.00	2.56	23.69	--- 11 3/4	26.25	102%
11	Replace Air Cell with Standard thick 85% Magnesia.	168.00	21.60	146.40	87.75	8.77	137.63	--- 7 1/4	146.40	166%
							Total Savings per year		$452.57	

*Based on a 10- (or_____) year amortization. This figure is very conservative as correctly chosen and properly applied insulations will usually outlast the equipment they cover.

EHRET MAGNESIA MANUFACTURING COMPANY • VALLEY FORGE • PENNA.

EHRET

HEAT INSULATIONS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. HI 100M

Printed in U. S. A.

SELECTION OF HEAT INSULATING MATERIALS

No one insulation is ideal for all purposes. Temperature range; exposure to water, chemicals, mechanical shocks or abrasion; the nature of the surface to be covered; initial cost and predictable savings, are a few of the more important factors determining the choice of insulating materials.

The following brief description of the more commonly used insulations is offered as a guide to their selection. Detailed descriptions and data relative to individual materials are, if not included in this catalog, readily available from the Ehret Co. and their representatives.

Ehret insulation specialists are ready at all times to discuss insulation problems, make recommendations, furnish materials, and apply them with the considerable skill that is needed to ensure obtaining full value from the materials used.

85% Magnesia

For over 40 years, 85% Magnesia has set thermal insulation standards. Whether used alone for temperatures up to 600°F. or, with an underlayer of high-temperature insulation, for temperatures as high as 2000°F., 85% Magnesia lasts indefinitely with no loss in its high initial insulating efficiency.

Light in weight, 85% Magnesia has plenty of structural strength; does not shrink or sag. Being a molded insulation, it is accurately machined to size, which ensures pipe coverings of a snug, heat-saving fit and uniform outside diameter. Properly applied, 85% Magnesia will withstand considerable vibration or mechanical shock, and it is not affected by moisture or wetting. It can be removed and re-applied without loss of efficiency or waste of materials.

The use of 85% Magnesia in conjunction with a high temperature insulating material permits its high efficiency and long life to effect extra savings with the insulating of temperatures up to 2000°F. This use of the two materials in combination is discussed below.

Diatomaceous Earth Insulations

For application directly on surfaces where temperatures range from 600°F. upwards to refractory temperatures (2000°F.), the insulating materials used are generally made from pre-calcined diatomaceous earths. There are two general classifications of materials in this group, namely, High Temperature Insulations and Insulating Brick.

For use with temperatures up to 2000°F., high temperature insulations are usually manufactured by adding a suitable fibrous binding ingredient such as asbestos fibre to a base of pre-calcined diatomaceous earths. Molded forms are accurately machined to size, and shrinkage is negligible when used on recommended temperatures.

Materials made in this way are, in general, easily handled, worked and applied; and they are usually unaffected by moisture, wetting, vibration or shock. However, they are not as light in weight, and their insulating efficiencies are slightly under that of 85% Magnesia. Consequently, high temperature insulations are commonly used in combination with 85% Magnesia so as to take advantage of Magnesia's lower cost and higher insulating efficiency.

When used in combination, for temperatures above 600°F., the high temperature material is applied directly to the heated surface in a thickness sufficient to lower the temperature at the inner surface of the 85% Magnesia to less than 600°F. Simply stated, the high temperature materials are used to protect the 85% Magnesia.

For temperatures up to 2000°F. it is generally more economical to use block insulation, because of its higher efficiency, fewer joints and economy of application. Certain equipment, however, is so designed as to necessitate the use of a brick-type insulation, or an insulation with a slightly higher mechanical strength. In such cases insulating brick should be used.

Usually made from pre-calcined diatomaceous earths, insulating bricks differ from the high

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temperature insulations in several ways. They are heavier, contain no fibrous binding ingredients and have greater structural strength. Their insulation value is lower than that of the high temperature materials. Available forms are limited to standard and special brick shapes.

Various diatomaceous earths are used to make insulating bricks of different characteristics. Generally, insulating bricks weigh about one-third as much as ordinary fire bricks. Their insulating value, when compared to fire brick, is approximately in inverse proportion to their relative weights.

For temperatures from 2000°F. to 2500°F. bricks are available that have insulating as well as refractory characteristics. These types are made from light weight fire clays and contain no diatomaceous earths, as a result of which they are lower in insulating value than diatomaceous earth bricks, but have refractory values which indicate their use in replacing ordinary fire brick.

Laminated Asbestos Felts

Laminated asbestos felts are mainly composed of many thin layers of asbestos paper, cemented together, with air voids between the layers. Several different methods of manufacture are used to form the air voids. The paper may be lightly crinkled; or finely ground materials, such as sponge or earth, may be used either in the paper or between layers to form the insulating air spaces.

The initial insulating efficiency of this type of material is high, but its use should be limited to conditions of extreme shock or vibration. Weight is relatively high, and since the materials are not homogeneous, there is a tendency to settle or loosen with subsequent loss in insulating efficiency. Laminated asbestos felts should not be used for temperatures over 600°F., and we do not recommend them for use when conditions of wetting are likely to be encountered.

Felted Asbestos Fibre

Materials that rely solely on asbestos fibre for their insulating value are not generally satisfactory. Asbestos, by itself, has fairly low insulating efficiency as compared with other materials, and the steady application of heat over a period of time tends to weaken the fibres, with the consequence that sagging and loosening will greatly decrease what initial insulating value the material may have had. Not recommended to withstand conditions of moisture or for use with temperatures above 700°F.

Cellular Asbestos
(AIR CELL TYPE)

This insulating material consists of layers of corrugated or flat-and-corrugated asbestos paper cemented together, varying from four to eight layers per inch of thickness.

Cellular asbestos, when properly applied, has fair initial insulation value. It is light in weight and low in first cost, but due to the shrinkage at joints and lack of mechanical strength, it does not have a long life of insulation efficiency. Its use is generally limited to hot water and steam heating systems, where temperatures do not exceed 300°F. and where initial expenditures are so limited as to prohibit the use of a permanent type of insulation.

Certain attempts have been made recently to improve the initial efficiency of air cell type insulations by increasing the number of layers of paper to as many as 15 to the inch of thickness. While this increase in the number of small air spaces has slightly improved its initial efficiency, it has not appreciably changed the inherent tendency of this type of insulation to shrink, sag and deteriorate.

Rock, Slag and Glass Wool

These materials consist of fine glass-like fibres that resemble raw cotton in general appearance. The individual fibres are, however, somewhat brittle, and as a consequence high initial insulating efficiency is likely to be short-lived under even normal industrial service conditions.

For application as a home or building insulation, rock, slag and glass wools are well suited.

Monolithic Cements

Such materials are not generally satisfactory when used as complete insulation covering because of the likely variations in thickness and density due to trowelling large areas. The use of those cements that have good physical characteristics is recommended for purposes such as covering fittings and irregularly shaped equipment and for finishing or filling-in over block insulation.

Metallic or "Reflecting Type"

These materials are relatively new in the insulation field, and since the methods of installation are mostly all complicated, proper application is difficult and uncertain. If moisture or chemical fumes dull the reflecting surfaces of the material used, its insulation value rapidly decreases to practically nothing. Service records of installations of reflecting type insulations have not been such as to warrant our recommendation.

Summary

A table has been prepared as a general guide for the selection of insulating materials. The characteristics, as given, refer to the materials in general, and not to specific products. The descriptive terms used in this table are relative.

Complete information about most of the materials listed, as well as information about other insulating materials, may be obtained from any Ehret representative.

Comparison of the Physical Characteristics of Heat Insulating Materials

Material	Temperature Range in Degrees F. From To	Weight	Initial Insulating Efficiency	Ability to Maintain Initial Insulating Efficiency Under Service Conditions	Ability to Withstand Conditions of:		Resistance to Shrinking and Sagging	Mechanical Strength	Re-Use Value
					Moisture or Wetting	Shock or Vibration			
Laminated Asbestos Cellular (Air Cell Type)	100— 300	Light	Fair	Poor	Poor	Fair	Poor	Fair	Poor
85% Magnesia	100— 600	Light	High	Excellent	Excellent	Good	Excellent	Good	Excellent
Laminated Asbestos Felt Types	100— 600	Fairly Heavy	High	Fair	Fair	Excellent	Poor	Good	Fair
Felted Asbestos Fibre Types	100— 700	Light	High	Fair	Fair	Fair	Poor	Good	Fair
Metallic or Reflecting Types	100—1000	Light	High	Poor	Poor	Poor	Poor	Poor	Poor
Rock, Slag and Glass Wools	100—1200	Light	High	Poor	Poor	Poor	Poor	Poor	Poor
"High Temperature" Insulations	600—2000	Fairly Light	High	Excellent	Excellent	Good	Excellent	Good	Excellent
Insulating Bricks	400—2500	Heavy	Good	Good	Good	Excellent	Excellent	Excellent	Good

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B.T.U.s and DOLLARS . . .

Heat losses, from bare hot pipes, mount into surprisingly large totals over even relatively short periods of time. And bare pipes are not the *only* wasters of heat. "Covered" pipes are quite often found, upon inspection, to be losing heat almost as rapidly as bare pipes. Shrinkage, sagging, low insulating efficiency, deterioration of the material and insufficient thickness, are responsible for the waste of millions of dollars worth of heat every year; and the unfortunate part of it all is that the losses are not suspected, because "the pipes are covered."

The following tables show the savings that can be effected by insulating with 85% Magnesia. They are based on results of over three years' work by the Mellon Institute of Industrial Research.

The table at the left shows the actual cash saving per month with $5.00 coal, of Standard thick 85% Magnesia as against bare pipes.

The other table shows in greater detail the serious losses which are going on in many plants today—losses which are largely preventable and which amount in total, to many millions of tons of coal, annually.

Monthly Saving, in Dollars and Cents, by the Use of "85% Magnesia" Pipe Covering,

Standard thickness, per 100 lineal feet of steam pipes.

Size of Pipe	5 Lbs. Steam Pressure	10 Lbs. Steam Pressure	50 Lbs. Steam Pressure	100 Lbs. Steam Pressure	150 Lbs. Steam Pressure	200 Lbs. Steam Pressure	200 Lbs. Steam Pressure 100° Superheat
½	$1.44	$1.58	$2.20	$3.28	$3.66	$4.11	$6.80
¾	1.72	1.89	2.87	3.70	4.26	4.89	8.03
1	2.11	2.30	3.56	4.80	5.35	6.04	10.00
1¼	2.52	2.74	4.22	5.52	6.50	7.25	12.20
1½	2.86	3.10	4.73	6.14	7.29	8.17	13.70
2	3.53	3.74	5.86	7.63	8.93	10.11	16.80
2½	4.25	4.39	6.95	9.07	10.55	11.90	19.90
3	5.00	5.33	8.30	10.90	12.60	14.30	23.82
3½	5.72	6.22	9.60	12.40	14.40	16.32	27.23
4	6.50	7.06	10.60	14.05	16.40	18.40	30.85
4½	7.30	7.69	11.80	15.35	17.92	20.25	34.00
5	7.97	8.64	13.16	17.20	20.00	22.72	38.00
6	9.36	10.15	15.60	20.38	23.82	26.88	44.90
7	10.90	11.70	18.38	23.68	27.60	30.80	52.00
8	12.26	13.22	20.40	26.60	31.20	34.90	58.55
9	13.80	14.70	22.70	29.00	34.52	38.61	64.80
10	15.08	16.33	25.00	32.70	38.40	43.08	72.40
100 sq. ft. 1¼" thick flat surface	5.26	5.67	8.80	11.50	13.48	15.12	25.44

These savings are based on pipes carrying steam 24 hours per day and 30 days per month.

Coal is figured at $5.00 per ton, delivered, with 14,000 B. T. U. per pound. Boiler efficiency is calculated at 70 per cent.

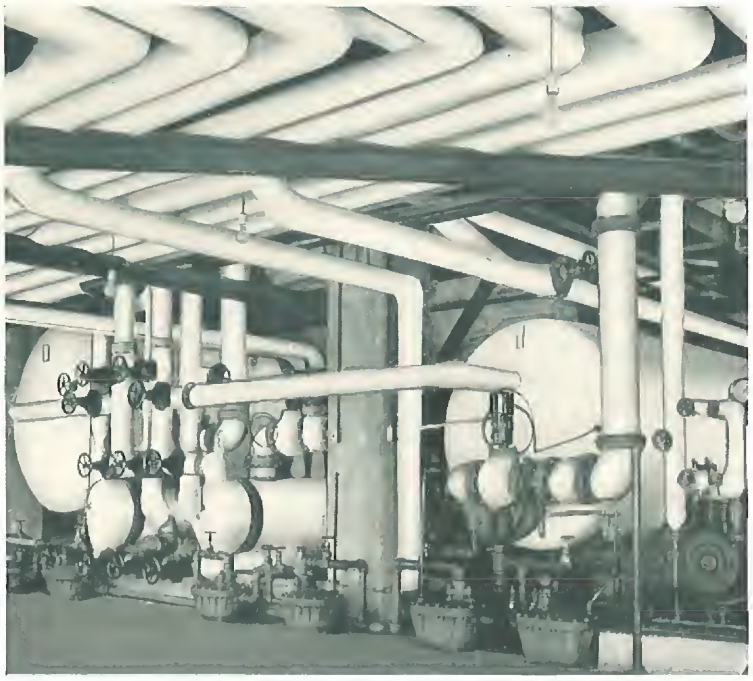
Amount of Coal Saved by "85% Magnesia" Pipe Covering, Standard Thick

Coal figured at 14,000 B. T. U. per lb. with boiler efficiency at 70 per cent.

Steam Pressure	Saturated 5 Lbs.	Saturated 10 Lbs.	Saturated 50 Lbs.	Saturated 100 Lbs.	Saturated 150 Lbs.	Saturated 200 Lbs.	200 Lbs. Pressure with 100° Superheat
Steam Temp. Deg. Fahr.	228	240	298	338	366	388	488
B. T. U. loss per hour sq. ft. bare pipe.	367	409	625	802	937	1058	1735
B. T. U. loss per hour sq. ft. of pipe covered with "85% Magnesia."	69	76	105	126	142	153	210
B. T. U. saved per sq. ft. by covering pipe with "85% Magnesia."	298	333	510	676	795	905	1525
Tons (2240 lbs.) coal saved per 10,000 sq. ft. per year of 8,760 hrs. by pipe covered with "85% Magnesia."	1190	1330	2080	2700	3180	3620	5650
Cars of coal saved per year, as above, at 40 tons per car.	30	36	52	68	80	90	140

This table is based on 3-inch pipe. The savings increase with the diameter of pipe. For flat surfaces add 27 per cent. to above figures. Still greater economy will be shown at pressures 100 lbs. and upwards by the use of greater thickness of 85% Magnesia.

Ehret's 85% Magnesia pipe covering, blocks and plastic cement were all used on the service equipment and steam lines illustrated at the right.



EHRET'S 85% MAGNESIA

THE STANDARD INSULATION

One of the outstanding characteristics of 85% Magnesia is its ability to maintain indefinitely its high initial insulating efficiency. When properly applied on services for which it is recommended, it can be depended upon to last as long, if not longer, than the piping or equipment on which it is applied.

Ehret's 85% Magnesia is a mechanical mixture of pure basic magnesium carbonate and carefully selected asbestos fibres. The magnesia in the resulting product is chiefly responsible for the insulating qualities, due to high percentage of minute dead-air spaces, and the asbestos fibres act as a heat resisting reinforcement to give structural strength and long life.

The length, quality and proper proportion of various kinds of asbestos fibre are chosen so that a maximum strength will be obtained with the use of a minimum of asbestos fibre. The amount of fibre used in Ehret's 85% Magnesia is kept under 15% so that the resulting product has a maximum of magnesia content for high insulating efficiency.

The density, and consequently the insulating efficiency, of 85% Magnesia varies according to the different manufacturing details employed. Some manufacturers make a product with a greater density and higher mechanical strength, and others sacrifice strength for better insulating characteristics. The Ehret Magnesia Manufacturing Company has developed a controlled hydraulic pressure method of molding the forms, which assures the lightest molded product with the greatest structural strength.

Due to its good transverse and compressive strength, it does not sag, buckle or shrink when in service. Molded forms of this material can be easily worked, applied, removed and re-used, with no waste of the material or loss in its insulating efficiency. In re-using, scrap pieces can be pulverized and mixed with water for application as a plastic cement. On drying, the cement regains original characteristics. Wetting or even long-time total immersion does it no harm, as has been strikingly shown by the inspection and re-use of 85% Magnesia installations on steamships that have been raised after years of total submersion.

85% Magnesia is chemically inert. Exposure to most chemicals or their fumes shows no harmful effects. It does not stick to or corrode the surfaces on which it is applied. Years of continuous use at temperatures up to 600°F. cause no change in its chemical composition. When used with temperatures above 600°F., it should be protected by a sufficiently thick underlayer of high temperature insulation, such as Ehret's Enduro, to prevent calcination with resultant loss in structural strength.

Ehret's 85% Magnesia is an economical material to use and apply. When properly applied on services such as hot water, low and high pressure steam and any other heated surfaces up to 600°F., provided they are not subjected to extreme conditions of mechanical shock or vibration, 85% Magnesia will give highly satisfactory service over a long period of years.

Complete information regarding recommended services and methods of application are available from the Ehret Magnesia Manufacturing Company and their representatives in special or catalog form.

Printed in U. S. A. 11-39

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THE MANUFACTURE OF EHRET'S 85% MAGNESIA INSULATING PRODUCTS

There are two basic ingredients in 85% Magnesia—namely, basic magnesium carbonate ($4\,Mg\,CO_3\;Mg\,(OH)_2\;5\,H_2O$, commonly called "Magnesia") and asbestos fibres. Its magnesia content accounts for 85% Magnesia's permanently high insulating efficiency, while the asbestos fibres provide structural reinforcement to give mechanical strength.

85% Magnesia is essentially a mass of minute dead air cells, formed by the interlocked walls of the crystalline flakes of which it is composed. This is the reason for its extreme lightness and for the ease with which it will absorb nearly three times its weight in water.

On the opposite page is a diagrammatic representation of the manufacture of Ehret's 85% Magnesia insulations. It shows various stages through which the materials pass from raw forms to finished products.

Dolomite rock is the material from which the magnesia is made. It is a hard rock, quarried from the Ehret Company's own quarries at Valley Forge, Pa., and it contains about 45% magnesium carbonate mixed with calcium carbonate, iron, clay, sand and other impurities.

The object of the chemical process is to change the magnesium carbonate content of the Dolomite into basic magnesium carbonate. During the course of this chemical processing, the magnesia is separated from accompanying impurities and is finally precipitated in water in a practically pure state.

Asbestos, the other component of 85% Magnesia, is obtained from veins which lie in hard rock. It is necessary to blast out about 100 tons of rock to obtain approximately six tons of asbestos. The asbestos must be broken away from the rock and crushed, screened and separated into fibres of various lengths. Carefully chosen types of asbestos fibres are added to the magnesia and thoroughly mixed.

This wet mixture of magnesia and asbestos fibres is next hydraulically molded into oversized standard shapes of various sizes. Drying the molded forms requires from 3 to 6 days because the insulating value of the magnesia is so high that heat cannot penetrate it and drive out the moisture in less time.

Planing all surfaces of the rough molded sections to close-tolerance dimensions by special machinery, completes the manufacturing process.

Modern practice, founded on long experience, has settled upon the proportion of at least 85% basic magnesium carbonate with asbestos as a binder to obtain a product that has maximum non-conducting character, combined with the requisite structural strength to insure durability.

EHRET
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EHRET'S 85% MAGNESIA MANUFACTURING PROCESS

DOLOMITE ROCK
$CaCO_3$ and $MgCO_3$

CRUSHED AND MIXED WITH COKE (C)

KILN

$C + 2O = CO_2 + HEAT$

$CaCO_3 + MgCO_3 + HEAT = CaO + MgO + 2CO_2$

WASHING COMPRESSING and COOLING
CO_2

SLAKING

$CaO + MgO + 2H_2O = Ca(OH)_2 + Mg(OH)_2$ (IN WATER)

SATURATING

$Ca(OH)_2 + Mg(OH)_2 + 3CO_2 = Mg(HCO_3)_2$ (IN SOLUTION) $+ CaCO_3$ (PRECIPITATED) $+ H_2O$

FILTER
$CaCO_3$ (OUT)

BOILING

$5Mg(HCO_3)_2 + H_2O + HEAT = 4MgHCO_3 \cdot Mg(OH)_2 \cdot 5H_2O + 6CO_2$

MAGNESIA
PRECIPITATED

FILTER MAGNESIA PRECIPITATE TO A WET PASTE

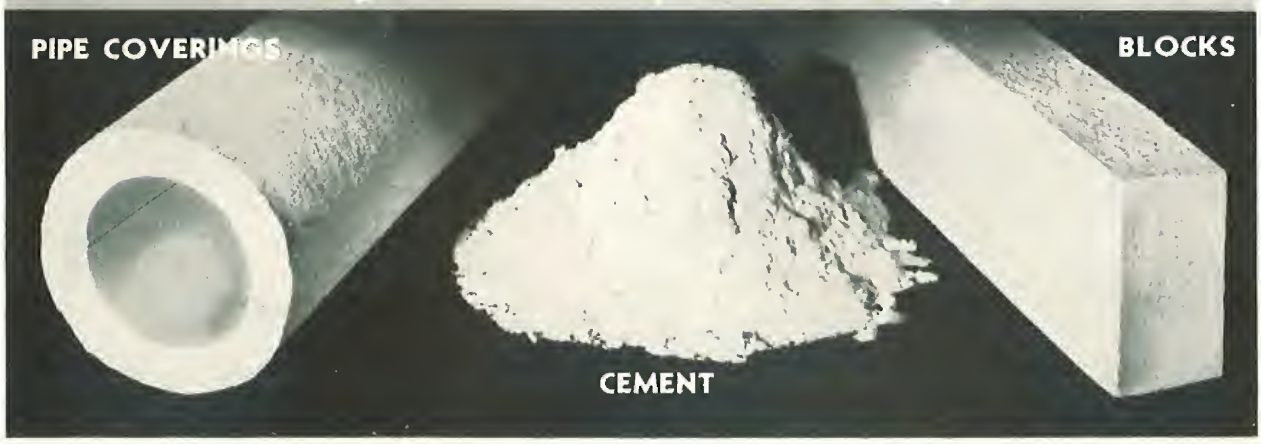
ASBESTOS FIBRE
10 to 15%

85% MAGNESIA MIXING

MOLDING AND DRYING

DRYING

MACHINING TO EXACT SIZE



EHRET'S 85% MAGNESIA PIPE COVERING

RECOMMENDED THICKNESSES

Pipe Size inches	Temperature of Hot Surface—Degrees F. 170	270	370	470	570	670		770		870		970		1070	
	Temperature Difference—Degrees F. 100	200	300	400	500	600		700		800		900		1000	
	85% Magnesia					Enduro	Magnesia	Enduro	Magnesia	Enduro	Magnesia	Enduro	Magnesia	Enduro	Magnesia
1	St'd	St'd	1½	2	2	2	..	2	..	2	..	2½	..	2½	..
2	St'd	St'd	1½	2	2	1½	1½	1½	2	2	2	2½	2	2½	2½
3	St'd	St'd	1½	2	2	1½	1½	1½	2	2	2	2½	2	2½	2½
4	St'd	St'd	1½	2	2	1½	1½	1½	2	2	2	2½	2	2½	2½
5	St'd	St'd	2	D.St'd	D.St'd	1½	2	1½	2	2	2	2½	2	2½	2½
6	St'd	St'd	2	D.St'd	D.St'd	1½	2	1½	2	2	2	2½	2	2½	2½
8	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
10	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
12	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
14	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
16	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
18	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
20	St'd	St'd	2	D.St'd	D.St'd	1½	2	2	2	2	2½	2½	2½	3	2
Flat	1½	1½	2	2½	3	1½	2	2	2	2	2½	2½	2½	3	2

D. St'd—Double Standard thickness

B.T.U.'S SAVED BY RECOMMENDED THICKNESSES /lineal foot/hour

1	64	160	315	527	798	1129	1534	2015	2688	3200
2	117	293	562	938	1422	2049	2804	3686	4722	5951
3	168	418	803	1351	2058	2976	4089	5390	6886	8571
4	215	533	1015	1714	2617	3796	5221	6884	8806	10950
5	262	649	1276	2116	3227	4704	6417	8462	10836	13509
6	310	769	1516	2522	3835	5581	7618	10053	12913	16058
8	403	1009	1958	3286	5000	7234	9924	13106	16826	20870
10	498	1249	2430	4085	6216	8980	12345	16301	20869	25905
12	595	1495	2870	4849	7381	10634	14600	19297	24758	30725
14	650	1625	3126	5288	8059	11616	15952	21096	27080	33612
16	740	1843	3553	6013	9171	13228	18174	24048	30878	38339
18	831	2070	3992	6747	10296	14862	20436	27046	34738	43142
20	919	2291	4417	7471	11383	16503	22626	29961	38479	47800
Flat	169	420	809	1353	2082	3002	4131	5459	7047	8724

TONS OF COAL SAVED BY RECOMMENDED THICKNESSES /100 lineal ft./year

1	3.6	9.0	17.7	29.7	44.8	64	87	113	151	180
2	6.6	16.4	31.5	52.8	81.0	114	158	207	265	334
3	9.4	23.5	45.3	74.0	116.	168	228	303	387	481
4	12.1	30.0	56.5	96.5	147.	213	294	387	495	615
5	14.7	36.4	71.8	119.	182.	265	363	477	609	759
6	17.4	43.2	85.5	142.	216.	313	430	562	725	902
8	22.5	56.2	110.	188.	281.	406	558	736	945	1172
10	27.8	70.9	136.	228.	350.	504	693	915	1172	1455
12	33.5	84.5	163.	273.	415.	597	820	1083	1390	1726
14	36.4	91.8	176.	297.	452.	653	895	1184	1521	1888
16	41.5	104.	198.	340.	517.	742	1020	1350	1734	2153
18	46.7	116.	224.	379.	578.	835	1148	1519	1951	2423
20	51.6	129.	248.	420.	640.	927	1271	1683	2161	2684
Flat	9.5	23.6	45.4	76.	117.	169	232	307	396	490

FOR TEMPERATURES UP TO 600° F.

EHRET'S 85% MAGNESIA PIPE COVERING

Ehret's 85% Magnesia, as described on accompanying data sheets, is an ideal material for covering pipes whose temperatures range up to 600° F. Its average weight is approximately 15 pounds per cubic foot.

The various sizes and forms of Ehret's 85% Magnesia Pipe Coverings are as follows:

Lengths

All Ehret's 85% Magnesia Pipe Coverings are supplied in 3-foot lengths.

Thicknesses

Single layer	Double layer
†"Standard"	†"Double Standard"
1½ inch	3 inch
2 "	*
2½ "	

† For actual thicknesses of the Standard classifications, see table on the other side of this sheet.

* Where thicknesses greater than 3 inches are desired, they may be attained by using 2 or more layers.

Pipe Sizes ½" to 12"

For pipes from ½" up to and including 12", Ehret's 85% Magnesia coverings are, with the exceptions noted, furnished in Sectional (semi-circular) form, with regulation canvas jacket and metal bands. If desired, the regulation canvas jacket can be left off, and each section will be wrapped in Kraft paper when requested. Sectional coverings, from ½" up to 5" in size, will be packed in cartons unless crates are desired. Sizes from 6" to 12" inclusive, are packed in crates only.

EXCEPTIONS—Outer layers of Double Standard coverings for pipes 10" and up, are SEGMENTAL.

Outer layers of 3" thick coverings for pipes 9" and up are SEGMENTAL.

Pipe Sizes 12" and up

85% Magnesia for pipes 12" or larger are furnished in Segmental form. The single layer 12" coverings are also available in Sectional form as previously noted.

All segments are approximately 5" in width along the inner arc, and the segmental widths supplied are such as to exactly fit the circumference of the pipe to be covered without the use of an odd-width segment. An accompanying table shows the number of segments per section for different pipe sizes.

Segmental insulation is regularly furnished without canvas or bands and is always packed in cases.

Weatherproofing Jackets

When desired, weatherproofing jackets can be furnished for 85% Magnesia Pipe Coverings. Jackets are available as an integral part of the pipe covering and shipped from the factory as such, or the jackets may be furnished separately in cut or roll form and applied on the insulation after it has been installed. Recommendations of various types of weatherproofing jackets are described on the data sheet "Specifications for Ehret's 85% Magnesia Pipe Covering."

Printed in U. S. A. 11-39

Dimensions of Ehret's 85% Magnesia Pipe Coverings

Stand. Steel or W. I. Pipe Nominal Size	Inside Diam. of Covering	Standard Thickness			Double Standard Thickness					1½" Thick		2" Thick		2½" Thick		3" Thick (Double 1½")	
		Thickness	Outside Diam.	Canvas Area per lineal foot	Thickness			Outside Diam.	Canvas Area per lineal foot	Outside Diam.	Canvas Area per lineal foot	Outside Diam.	Canvas Area per lineal foot	Outside Diam.	Canvas Area per lineal foot	Outside Diam.	Canvas Area per lineal foot
					Inside layer	Outside layer	Total Thickness										
Inches	Inches	Inches	Inches	Square feet	Inches	Inches	Inches	Inches	Square feet	Inches	Square feet	Inches	Square feet	Inches	Square feet	Inches	Square feet
½	⅞	⅞	2⅝	.688	⅞	1 1/32	1 29/32	4 11/16	1.2292	3⅞	1.0145	4⅞	1.2763	5⅞	1.5375	6⅞	1.7971
¾	1⅛	⅞	2⅞	.753	⅞	1 1/32	1 29/32	4 15/16	1.2926	4⅛	1.0799	5⅛	1.3417	6⅛	1.6040	7⅛	1.8660
1	1⅜	⅞	3⅛	.818	⅞	1 1/32	1 29/32	5 3/16	1.3583	4⅜	1.1454	5⅜	1.4072	6⅜	1.6783	7⅜	1.9300
1¼	1¾	⅞	3½	.917	⅞	1 1/32	1 29/32	5 9/16	1.4558	4¾	1.2436	5¾	1.5054	6¾	1.7667	7¾	2.0283
1½	1 15/16	⅞	3 11/16	.964	⅞	1 1/32	1 29/32	5¾	1.5054	4 15/16	1.2926	5 15/16	1.5545	6 15/16	1.8164	7 15/16	2.0782
2	2 7/16	1 1/32	4½	1.177	1 1/32	1⅛	2 5/32	6¾	1.7667	5 7/16	1.4235	6 7/16	1.6854	7 7/16	1.9467	8 7/16	2.2092
2½	2 15/16	1 1/32	5	1.307	1 1/32	1⅛	2 5/32	7¼	1.9000	5 15/16	1.5545	6 15/16	1.8164	7 15/16	2.0782	8 15/16	2.3400
3	3 9/16	1 1/32	5⅝	1.471	1 1/32	1⅛	2 5/32	7⅞	2.0630	6 9/16	1.7181	7 9/16	1.9800	8 9/16	2.2420	9 9/16	2.5034
3½	4 1/16	1 1/32	6⅛	1.604	1 1/32	1⅛	2 5/32	8⅜	2.1925	7 1/16	1.8490	8 1/16	2.1108	9 1/16	2.3725	10 1/16	2.6340
4	4 9/16	1⅛	6 13/16	1.781	1⅛	1⅛	2¼	9 1/16	2.3725	7 9/16	1.9800	8 9/16	2.2420	9 9/16	2.5034	10 9/16	2.7650
4½	5 1/16	1⅛	7 5/16	1.917	1⅛	1⅛	2¼	9 9/16	2.5034	8 1/16	2.1108	9 1/16	2.3725	10 1/16	2.6340	11 1/16	2.8960
5	5⅝	1⅛	7⅞	2.063	1⅛	1⅛	2¼	10⅛	2.6500	8⅝	2.2580	9⅝	2.5200	10⅝	2.7808	11⅝	3.0434
6	6¾	1⅛	9	2.360	1⅛	1⅛	2¼	11¼	2.9430	9¾	2.5525	10¾	2.8145	11¾	3.0762	12¾	3.3380
7	7¾	1¼	10¼	2.683	1¼	1¼	2½	12¾	3.3380	10¾	2.8145	11¾	3.0762	12¾	3.3380	13¾	3.5992
8	8¾	1¼	11¼	2.943	1¼	1¼	2½	13¾	3.5992	11¾	3.0762	12¾	3.3380	13¾	3.5992	14¾	3.8607
9	9⅞	1¼	12⅜	3.240	1¼	1¼	2½	14⅞	3.8941	12⅞	3.3707	13⅞	3.6326	14⅞	3.8941	15⅞	4.1560
10	10⅞	1¼	13⅜	3.537	1¼	1¼	2½	15⅞	4.1558	13⅞	3.6326	14⅞	3.8941	15⅞	4.1560	16⅞	4.4180
11	11⅞	1½	14⅜	3.8941	1½	1½	3	17⅞	4.6800	14⅞	3.8941	15⅞	4.1560	16⅞	4.4180	17⅞	4.6800
12	12⅞	1½	15⅜	4.1560	1½	1½	3	18⅞	4.9408	15⅞	4.1560	16⅞	4.4180	17⅞	4.6800	18⅞	4.9408
14	14	1½	17	4.4500	1½	1½	3	20	5.2358	17	4.4500	18	4.7116	19	4.9741	20	5.2358
15	15	1½	18	4.7116	1½	1½	3	21	5.4975	18	4.7116	19	4.9741	20	5.2358	21	5.4975
16	16	1½	19	4.9741	1½	1½	3	22	5.7592	19	4.9741	20	5.2358	21	5.4975	22	5.7592
17	17	1½	20	5.2358	1½	1½	3	23	6.0208	20	5.2358	21	5.4975	22	5.7592	23	6.0208
18	18	1½	21	5.4975	1½	1½	3	24	6.2825	21	5.4975	22	5.7592	23	6.0208	24	6.2825
19	19	1½	22	5.7592	1½	1½	3	25	6.5450	22	5.7592	23	6.0208	24	6.2825	25	6.5450
20	20	1½	23	6.0208	1½	1½	3	26	6.8067	23	6.0208	24	6.2825	25	6.5450	26	6.8067
21	21	1½	24	6.2825	1½	1½	3	27	7.0683	24	6.2825	25	6.5450	26	6.8067	27	7.0683
22	22	1½	25	6.5450	1½	1½	3	28	7.3300	25	6.5450	26	6.8067	27	7.0683	28	7.3300
23	23	1½	26	6.8067	1½	1½	3	29	7.5916	26	6.8067	27	7.0683	28	7.3300	29	7.5916
24	24	1½	27	7.0683	1½	1½	3	30	7.8534	27	7.0683	28	7.3300	29	7.5916	30	7.8534
26	26	1½	29	7.5916	1½	1½	3	32	8.3750	29	7.5916	30	7.8534	31	8.1150	32	8.3750
27	27	1½	30	7.8534	1½	1½	3	33	8.6334	30	7.8534	31	8.1150	32	8.3750	33	8.6334
28	28	1½	31	8.1150	1½	1½	3	34	8.9000	31	8.1150	32	8.3750	33	8.6334	34	8.9000
30	30	1½	33	8.6334	1½	1½	3	36	9.4167	33	8.6334	34	8.9000	35	9.1583	36	9.4167
32	32	1½	35	9.1583	1½	1½	3	38	9.9416	35	9.1583	36	9.4167	37	9.6834	38	9.9416
33	33	1½	36	9.4167	1½	1½	3	39	10.2834	36	9.4167	37	9.6834	38	9.9416	39	10.2834

EHRET INSULATIONS

PACKAGING DATA

Ehret's 85% Magnesia Pipe Coverings

NUMBER OF SECTIONS IN, AND WEIGHTS OF, STANDARD SHIPPING CARTON
(Standard thickness coverings only)

Pipe Size	Number of Sections in a Carton	Approximate Weight per Carton	Size of Bands Supplied
½″	34	65	¾″ x 9¾″
¾″	30	65	¾″ x 10½″
1″	24	60	¾″ x 11¼″
1¼″	20	55	¾″ x 12¾″
1½″	30	85	¾″ x 13¼″
2″	20	95	¾″ x 15½″
2½″	16	75	¾″ x 17½″
3″	13	70	¾″ x 19″
3½″	10	60	¾″ x 21″
4″	9	70	1″ x 23″
4½″	7	50	1″ x 25¼″
5″	6	65	1″ x 26″

Additional Sections that can be Nested

In 1 carton of 3″ –13 Sections of 1″, ¾″ or ½″
" 3½″–10 Sections of 1¼″, 1″, ¾″ or ½″
" 4″ – 9 Sections of 1½″, 1¼″, 1″, ¾″ or ½″
" 4½″– 7 Sections of 2″, 1½″, 1¼″, 1″, ¾″ or ½″
" 5″ – 6 Sections of 2½″, 2″, 1½″, 1¼″, 1″, ¾″ or ½″

NUMBER OF SECTIONS IN, AND WEIGHT OF, STANDARD SHIPPING CRATES
(Standard thickness coverings only)

Pipe Size	Number of Sections in Crates	Approximate Weight per Crate	Size of Bands Supplied
½″	143	315	¾″ x 9¾″
¾″	130	310	¾″ x 10½″
1″	100	280	¾″ x 11¼″
1¼″	80	290	¾″ x 12¾″
1½″	69	270	¾″ x 13¼″
2″	53	270	¾″ x 15½″
2½″	40	240	¾″ x 17½″
3″	33	230	¾″ x 19″
3½″	27	201	¾″ x 21″
4″	22	210	1″ x 23″
4½″	20	210	1″ x 25¼″
5″	16	200	1″ x 26″
6″	12	190	1″ x 30½″
7″	9	160	1″ x 34″
8″	8	185	1″ x 37½″
9″	7	185	1″ x 40½″
10″	5	165	1″ x 44¼″
12″	4	200	1″ x 53″

NUMBER OF SECTIONS IN STANDARD SHIPPING CRATE

Thickness of Pipe Covering	Nominal Pipe Size in Inches																	
	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
Standard	143	130	100	80	69	54	40	33	27	22	20	16	12	9	8	7	5	4
1½″ thick	80	63	54	48	40	35	28	24	20	18	13	13	9	8	7	5	4	4
2″ thick	42	40	35	30	28	24	20	18	16	13	12	10	8	7	5	4	4	4
D. S. B. J.	40	40	33	30	30	22	20	18	14	12	10	9	6	7	5	4	4	
D. S. OSL only	130	130	80	80	63	54	40	33	27	22	20	16	12	9	8	7	5	
3″ thick	20	20	18	18	16	12	12	10	9	9	8	7	5	4	4	4		
3″ OSL only	63	63	48	48	40	35	28	24	20	18	13	13	10	8	7	5		
ISL / OSL																		
Std. / 1½″	28	28	24	24	20	18	13	13	11	10	9	8	7	5	4	4		
Std. / 2″	20	20	18	18	16	13	12	10	9	9	8	7	5	4	4	4		
1½″ / 2″	16	16	13	12	10	9	7	6	6	5	5	4	4	4	4	4		
1½″ / 3″	9	9	8	8	7	7	5	5	4	4	4	4	4					
2″ / 2″	12	12	10	9	9	9	8	7	6	5	4	4	4	4	4			

D. S. B. J.—Double Standard Broken Joint OSL—Outside Layer ISL—Inside Layer

Printed in U. S. A. 11-39

EHRET
INSULATIONS

PACKAGING DATA

Ehret's 85% Magnesia Pipe Coverings

NUMBER OF SEGMENTS PER SECTION AND
NUMBER OF SEGMENTS AND SECTIONS IN STANDARD SHIPPING CASE

Nominal Pipe Size in Inches	Thickness of Pipe Covering								
	1½"—ISL of D. S. B. J. or 3"			OSL of D. S. B. J. or 3"			2"		
	Seg./Sec.	Seg./Case	Sec./Case	Seg./Sec.	Seg./Case	Sec./Case	Seg./Sec.	Seg./Case	Sec./Case
10	..	..	....	8	60	7.5	..	..	....
11	..	..	....	8	60	7.5	..	..	....
12	8	60	7.5	9	60	6.67	8	44	4.88
13	8	60	7.5	9	60	6.67	8	44	4.88
14	8	60	7.5	10	60	6	8	44	4.4
15	9	60	6.67	10	60	6	9	44	4
16	9	60	6.67	10	60	6	9	44	3.66
17	10	60	6	12	60	5	10	44	3.66
18	10	60	6	12	60	5	10	44	3.66
19	11	60	5.45	12	60	5	11	44	3.38
20	12	60	5	12	60	5	12	44	3.14
22	12	60	5	14	60	4.28	12	44	2.93
24	14	60	4.28	15	60	4	14	44	2.75
26	15	60	4	16	60	3.75	15	44	2.44
28	16	60	3.75	18	60	3.33	16	44	2.31
30	18	60	3.33	19	60	3.16	18	44	2.2
36	19	60	3.16	20	60	3	19	44	2.09

D. S. B. J.—Double Standard Broken Joint ISL—Inside Layer OSL—Outside Layer

Expansion bend in an 8" steam line that is protected with Ehret's 85% Magnesia 2" thick

Preparing a corrugated boiler for the application of Ehret's 85% Magnesia blocks

Detail of one of the boilers illustrated at the left, showing the method of trowelling on 85% Magnesia cement as an underlayer for 2" blocks of the same material

EHRET'S 85% MAGNESIA PIPE COVERING

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in B.T.U.s per Square Foot pipe surface per Hour per Degree of temperature difference between pipe and air

Pipe Temperature		170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference		100° F.		200° F.		300° F.		400° F.		500° F.	
Pipe Size	Thick-ness	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
½	Bare	2.700	.....	3.210	.....	3.840	.....	4.570	.....	5.410	.....
	St'd	.750	72.23	.800	75.08	.850	77.87	.900	80.31	.950	82.44
	1½	.620	77.04	.650	79.75	.690	82.03	.721	84.22	.752	86.10
	D. St'd	.552	79.56	.582	81.87	.612	84.06	.642	85.95	.675	87.52
	2	.545	79.83	.565	82.40	.590	84.63	.620	86.43	.650	87.98
	2½	.501	81.82	.525	83.64	.557	85.50	.580	87.31	.605	88.82
	3	.462	82.90	.483	84.96	.515	86.59	.535	88.29	.560	89.65
	3½	.434	83.92	.455	85.82	.476	87.60	.497	89.12	.519	90.40
	4	.425	84.26	.446	86.11	.463	87.90	.482	89.45	.500	90.76
¾	Bare	2.570	.....	3.070	.....	3.680	.....	4.420	.....	5.250	.....
	St'd	.695	72.96	.738	75.96	.782	78.75	.825	81.33	.870	83.43
	1½	.550	78.60	.582	81.04	.615	83.29	.632	85.70	.666	87.31
	D. St'd	.493	80.82	.519	83.09	.545	85.19	.571	87.08	.597	88.63
	2	.485	81.13	.505	83.55	.534	85.49	.555	87.44	.583	88.90
	2½	.435	83.08	.460	85.01	.488	86.74	.513	88.40	.435	89.83
	3	.402	84.36	.422	86.25	.447	87.85	.463	89.52	.486	90.74
	3½	.363	85.88	.384	87.49	.405	89.00	.426	90.36	.446	91.51
	4	.357	86.11	.377	87.92	.397	89.21	.417	90.65	.436	91.70
1	Bare	2.500	.....	3.000	.....	3.600	.....	4.340	.....	5.160	.....
	St'd	.637	74.52	.678	77.40	.718	80.01	.760	82.49	.802	84.45
	1½	.500	80.00	.523	82.57	.558	84.50	.585	86.52	.607	88.22
	D. St'd	.443	82.28	.466	84.47	.489	86.39	.512	88.20	.536	89.61
	2	.437	82.52	.453	84.90	.476	86.78	.498	88.52	.523	89.86
	2½	.386	84.56	.409	86.37	.432	88.00	.452	89.58	.473	90.83
	3	.361	85.56	.377	87.43	.399	88.91	.417	90.39	.436	91.55
	3½	.333	86.68	.349	88.37	.365	89.86	.383	91.17	.399	92.26
	4	.320	87.20	.335	88.83	.350	90.30	.364	91.61	.380	92.63
1¼	Bare	2.450	.....	2.940	.....	3.540	.....	4.280	.....	5.090	.....
	St'd	.580	76.32	.619	78.94	.658	81.41	.696	83.73	.732	85.61
	1½	.452	81.55	.477	83.77	.510	85.58	.530	87.61	.553	89.13
	D. St'd	.402	83.59	.422	85.64	.442	87.51	.462	89.20	.482	90.53
	2	.395	83.88	.410	86.05	.430	87.85	.450	89.49	.470	90.76
	2½	.350	85.71	.367	87.52	.386	89.09	.408	90.46	.425	91.65
	3	.317	87.06	.332	88.71	.352	90.06	.370	91.35	.387	92.39
	3½	.293	88.04	.311	89.42	.328	90.73	.344	91.96	.361	92.91
	4	.275	88.77	.293	90.23	.311	91.51	.329	92.31	.350	93.12
1½	Bare	2.410	.....	2.900	.....	3.500	.....	4.230	.....	5.030	.....
	St'd	.552	77.09	.589	79.69	.626	82.11	.663	84.09	.700	86.08
	1½	.430	82.15	.454	84.34	.477	86.38	.510	87.94	.527	89.52
	D. St'd	.376	84.40	.395	86.38	.415	88.14	.434	89.74	.455	90.95
	2	.370	84.65	.387	86.72	.406	88.40	.425	90.00	.445	91.15
	2½	.326	86.47	.345	88.10	.364	89.60	.380	91.01	.398	92.08
	3	.296	87.72	.312	89.24	.332	90.51	.345	91.82	.360	92.84
	3½	.274	88.63	.290	90.00	.304	91.31	.320	92.43	.335	93.34
	4	.256	89.38	.272	90.62	.288	91.77	.304	92.81	.319	93.66
2	Bare	2.350	.....	2.850	.....	3.450	.....	4.160	.....	4.980	.....
	St'd	.471	80.00	.501	82.42	.530	84.61	.559	86.56	.590	88.15
	1½	.392	83.32	.415	85.40	.445	87.10	.463	88.87	.483	90.30
	D. St'd	.320	86.38	.335	88.25	.353	89.76	.371	91.08	.390	92.18
	2	.337	85.66	.360	87.37	.374	89.16	.392	90.58	.408	91.80
	2½	.283	87.96	.310	89.11	.330	90.43	.342	91.77	.360	92.80
	3	.269	88.55	.282	90.10	.300	91.11	.310	92.55	.325	93.47
	3½	.246	89.50	.258	90.94	.270	92.17	.284	93.17	.297	94.04
	4	.230	90.21	.242	91.51	.254	92.63	.267	93.58	.280	94.40

Printed in U. S. A. 11-39

EHRET
INSULATIONS

EHRET'S 85% MAGNESIA PIPE COVERING

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in B.T.U.s per Square Foot pipe surface per Hour per Degree of temperature difference between pipe and air

Pipe Temperature		170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference		100° F.		200° F.		300° F.		400° F.		500° F.	
Pipe Size	Thick-ness	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
2½	Bare	2.290	.....	2.780	.....	3.370	.....	4.090	.....	4.910	.....
	St'd	.443	80.65	.473	83.00	.503	85.07	.531	87.00	.560	88.60
	1½	.375	83.53	.395	85.79	.421	87.51	.441	89.22	.462	90.59
	D. St'd	.300	86.89	.316	88.63	.332	90.15	.348	91.50	.363	92.61
	2	.320	86.02	.339	87.81	.353	89.52	.370	90.95	.385	92.16
	2½	.273	88.08	.287	89.68	.306	90.92	.319	91.90	.333	93.23
	3	.247	89.21	.260	90.65	.276	91.81	.286	93.01	.300	93.90
	3½	.226	90.13	.240	91.37	.250	92.58	.262	93.59	.274	94.41
	4	.210	90.83	.222	92.01	.234	93.05	.246	93.98	.257	94.76
3	Bare	2.250	.....	2.730	.....	3.310	.....	4.030	.....	4.850	.....
	St'd	.420	81.34	.449	83.56	.474	85.68	.503	87.52	.535	88.97
	1½	.350	84.45	.365	86.63	.392	88.15	.410	89.84	.430	91.13
	D. St'd	.285	87.34	.302	88.94	.318	90.39	.334	91.71	.349	92.80
	2	.302	86.58	.318	88.35	.333	90.00	.349	91.34	.362	92.53
	2½	.256	88.62	.270	90.11	.286	91.36	.295	92.68	.312	93.57
	3	.230	89.78	.245	91.03	.255	92.30	.268	93.35	.280	94.23
	3½	.209	90.71	.221	91.90	.234	92.93	.246	93.90	.256	94.72
	4	.195	91.34	.207	92.41	.219	93.39	.231	94.27	.240	95.05
3½	Bare	2.220	.....	2.690	.....	3.270	.....	3.980	.....	4.800	.....
	St'd	.409	81.58	.436	83.79	.461	85.91	.489	87.51	.517	89.23
	1½	.344	84.55	.358	86.69	.380	88.38	.397	90.03	.419	91.27
	D. St'd	.275	87.61	.291	89.18	.307	90.61	.323	91.88	.339	92.94
	2	.287	87.07	.304	88.69	.319	90.21	.333	91.63	.345	92.81
	2½	.243	89.05	.257	90.44	.271	91.71	.283	92.86	.295	93.85
	3	.218	90.18	.231	91.41	.242	92.63	.254	93.61	.266	94.46
	3½	.196	91.17	.206	92.34	.216	93.39	.226	94.07	.239	95.02
	4	.185	91.67	.195	92.79	.205	93.73	.215	94.60	.225	95.32
4	Bare	2.190	.....	2.660	.....	3.240	.....	3.950	.....	4.770	.....
	St'd	.369	83.15	.399	85.00	.431	86.39	.462	88.30	.495	89.62
	1½	.332	84.84	.350	86.84	.370	88.58	.386	90.23	.408	91.45
	D. St'd	.255	88.36	.269	89.89	.283	91.26	.297	92.48	.311	93.48
	2	.276	87.39	.290	89.09	.304	90.62	.318	91.95	.331	93.06
	2½	.235	89.27	.248	90.67	.263	91.88	.274	93.07	.285	94.03
	3	.206	90.59	.218	91.81	.230	92.90	.241	93.90	.253	94.70
	3½	.190	91.32	.199	92.44	.207	93.61	.216	94.50	.228	95.22
	4	.175	92.01	.184	93.09	.194	94.01	.203	94.86	.213	95.53
4½	Bare	2.170	.....	2.630	.....	3.220	.....	3.920	.....	4.740	.....
	St'd	.361	83.36	.391	85.13	.421	86.91	.451	88.49	.482	89.83
	1½	.326	84.98	.343	86.96	.360	88.82	.374	90.45	.397	91.62
	D. St'd	.246	88.66	.259	90.15	.272	91.55	.286	92.71	.299	93.69
	2	.268	87.65	.280	89.34	.294	90.87	.308	92.14	.321	93.22
	2½	.225	89.63	.235	91.06	.249	92.26	.258	93.42	.271	94.28
	3	.199	90.83	.211	91.97	.224	93.04	.235	94.01	.246	94.81
	3½	.185	91.47	.193	92.66	.201	93.75	.210	94.64	.219	95.37
	4	.165	92.39	.175	93.34	.185	94.25	.195	95.02	.205	95.67
5	Bare	2.150	.....	2.610	.....	3.200	.....	3.900	.....	4.710	.....
	St'd	.356	83.44	.385	85.21	.414	87.06	.443	88.64	.469	90.05
	1½	.314	85.40	.333	87.24	.352	89.00	.371	90.49	.388	91.76
	D. St'd	.236	89.02	.248	90.49	.260	91.87	.272	93.05	.284	93.98
	2	.258	88.00	.270	89.65	.285	91.09	.298	92.36	.312	93.38
	2½	.214	90.04	.224	91.41	.239	92.53	.248	93.64	.258	94.52
	3	.193	91.02	.204	92.19	.217	93.21	.229	94.13	.239	94.92
	3½	.178	91.72	.186	92.87	.194	93.93	.202	94.82	.210	95.54
	4	.158	92.65	.168	93.57	.178	94.50	.188	95.18	.197	95.82

EHRET'S 85% MAGNESIA PIPE COVERING

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in B.T.U.s per Square Foot pipe surface per Hour per Degree of temperature difference between pipe and air

Pipe Temperature		170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference		100° F.		200° F.		300° F.		400° F.		500° F.	
Pipe Size	Thick-ness	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
6	Bare	2.130	.....	2.590	.....	3.180	.....	3.890	.....	4.690	.....
	St'd	.348	83.67	.376	85.49	.403	87.32	.430	88.95	.460	90.19
	1½	.302	85.82	.314	87.88	.335	89.46	.353	90.93	.370	92.11
	D. St'd	.224	89.49	.236	90.89	.248	92.20	.260	93.32	.272	94.20
	2	.243	88.59	.258	90.04	.270	91.50	.285	92.67	.295	93.71
	2½	.205	90.37	.218	91.58	.230	92.76	.240	93.83	.252	94.62
	3	.182	91.46	.192	92.59	.203	93.61	.215	94.47	.225	95.20
	3½	.166	92.20	.174	93.27	.182	94.27	.190	95.11	.198	95.78
	4	.150	92.96	.158	93.90	.167	94.74	.176	95.47	.185	96.08
7	Bare	2.110	.....	2.570	.....	3.160	.....	3.870	.....	4.670	.....
	St'd	.313	85.16	.337	86.88	.360	88.60	.383	90.10	.408	91.26
	1½	.295	86.02	.306	88.09	.330	89.55	.346	91.06	.360	92.29
	D. St'd	.199	90.56	.211	91.79	.224	92.91	.235	93.93	.245	94.75
	2	.237	88.76	.249	90.31	.263	91.67	.275	92.89	.288	93.83
	2½	.199	90.56	.211	91.79	.224	92.91	.235	93.93	.245	94.75
	3	.175	91.70	.185	92.80	.195	93.82	.205	94.70	.215	95.39
	3½	.160	92.41	.168	93.42	.176	94.43	.184	95.24	.192	95.88
	4	.143	93.22	.151	94.12	.159	94.97	.169	95.63	.177	96.21
8	Bare	2.090	.....	2.560	.....	3.140	.....	3.860	.....	4.660	.....
	St'd	.309	85.22	.330	87.11	.354	88.72	.377	90.23	.399	91.44
	1½	.288	86.22	.301	88.24	.324	89.68	.342	91.14	.354	92.41
	D. St'd	.193	90.77	.205	92.00	.217	93.08	.228	94.10	.240	94.85
	2	.230	89.00	.240	90.62	.255	91.87	.266	93.11	.280	94.00
	2½	.193	90.77	.205	92.00	.217	93.09	.228	94.10	.240	94.85
	3	.169	91.91	.178	93.05	.188	94.01	.199	94.85	.210	95.50
	3½	.154	92.63	.162	93.67	.170	94.58	.179	95.36	.188	95.97
	4	.137	93.44	.145	94.33	.154	95.12	.162	95.81	.169	96.37
9	Bare	2.080	.....	2.550	.....	3.130	.....	3.850	.....	4.650	.....
	St'd	.306	85.29	.326	87.21	.346	88.94	.367	90.47	.391	91.59
	1½	.280	86.53	.296	88.39	.318	89.80	.331	91.40	.349	92.49
	D. St'd	.186	91.05	.198	92.23	.211	93.25	.223	94.20	.235	94.94
	2	.225	89.19	.236	90.74	.249	92.04	.261	93.22	.275	94.08
	2½	.186	91.05	.198	92.23	.211	93.25	.223	94.20	.235	94.94
	3	.164	92.11	.175	93.09	.185	94.09	.194	94.96	.205	95.59
	3½	.148	92.88	.156	93.84	.164	94.76	.172	95.53	.180	96.12
	4	.132	93.65	.140	94.51	.148	95.27	.156	95.94	.163	96.49
10	Bare	2.070	.....	2.540	.....	3.120	.....	3.840	.....	4.640	.....
	St'd	.303	85.36	.323	87.29	.343	89.00	.364	90.52	.385	91.70
	1½	.275	86.71	.292	88.51	.312	90.00	.326	91.51	.342	92.63
	D. St'd	.183	91.16	.194	92.36	.207	93.36	.218	94.32	.231	95.02
	2	.220	89.37	.232	90.87	.244	92.11	.256	93.33	.269	94.20
	2½	.183	91.16	.194	92.36	.207	93.36	.218	94.32	.231	95.02
	3	.160	92.27	.170	93.31	.180	94.23	.190	95.05	.200	95.70
	3½	.144	93.04	.150	94.09	.156	95.00	.164	95.73	.172	96.29
	4	.128	93.81	.136	94.65	.144	95.38	.152	96.04	.159	96.58
12	Bare	2.050	.....	2.520	.....	3.100	.....	3.810	.....	4.610	.....
	St'd	.270	86.83	.285	88.69	.305	90.16	.320	91.66	.334	92.76
	1½	.270	86.83	.285	88.69	.305	90.16	.320	91.66	.334	92.76
	D. St'd	.156	92.39	.166	93.43	.176	94.32	.186	95.12	.193	95.82
	2	.215	89.51	.228	90.95	.239	92.30	.252	93.39	.264	94.27
	2½	.180	91.21	.192	92.38	.204	93.42	.215	94.35	.226	95.10
	3	.156	92.39	.166	93.43	.176	94.32	.186	95.12	.193	95.82
	3½	.140	93.17	.146	94.20	.152	95.09	.158	95.85	.165	96.42
	4	.125	93.90	.134	94.70	.142	95.42	.150	96.07	.155	96.64

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Heat Losses are given in B.T.U.s per Square Foot pipe surface per Hour per Degree of temperature difference between pipe and air

Pipe Temperature		170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference		100° F.		200° F.		300° F.		400° F.		500° F.	
Pipe Size	Thickness	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
14	Bare	2.040	.....	2.500	.....	3.080	.....	3.790	.....	4.590	.....
	St'd	.267	86.91	.280	88.80	.300	90.25	.315	91.69	.330	92.81
	1½	.267	86.91	.280	88.80	.300	90.25	.315	91.69	.330	92.81
	D. St'd	.153	92.50	.162	93.52	.170	94.48	.180	95.25	.190	95.86
	2	.211	89.65	.225	91.00	.235	92.37	.249	93.43	.260	94.34
	2½	.178	91.27	.189	92.44	.202	93.44	.211	94.43	.222	95.16
	3	.153	92.50	.162	93.52	.170	94.48	.180	95.25	.190	95.86
	3½	.137	93.28	.143	94.28	.149	95.16	.155	95.91	.162	96.47
	4	.122	94.01	.130	94.80	.136	95.59	.144	96.20	.150	96.74
16	Bare	2.030	.....	2.480	.....	3.060	.....	3.770	.....	4.570	.....
	St'd	.263	87.05	.277	88.83	.295	90.36	.312	91.72	.327	92.84
	1½	.263	87.05	.277	88.83	.295	90.36	.312	91.72	.327	92.84
	D. St'd	.150	92.61	.158	93.63	.167	94.54	.176	95.33	.187	95.93
	2	.207	89.80	.221	91.09	.232	92.42	.244	93.53	.256	94.39
	2½	.176	91.33	.186	92.50	.199	93.46	.207	94.51	.218	95.23
	3	.150	92.61	.158	93.63	.167	94.54	.176	95.33	.187	95.93
	3½	.135	93.35	.141	94.31	.147	95.19	.153	95.94	.160	96.50
	4	.120	94.09	.128	94.84	.134	95.62	.141	96.26	.145	96.85
18	Bare	2.020	.....	2.470	.....	3.050	.....	3.750	.....	4.550	.....
	St'd	.260	87.13	.274	88.91	.292	90.43	.309	91.76	.323	92.90
	1½	.260	87.13	.274	88.91	.292	90.43	.309	91.76	.323	92.90
	D. St'd	.147	92.72	.156	93.68	.165	94.59	.174	95.36	.184	95.96
	2	.204	89.90	.217	91.21	.230	92.46	.240	93.60	.253	94.44
	2½	.174	91.38	.182	92.63	.195	93.60	.203	94.59	.214	95.29
	3	.147	92.72	.156	93.68	.165	94.59	.174	95.36	.184	95.96
	3½	.133	93.41	.139	94.36	.145	95.24	.151	95.97	.157	96.55
	4	.118	94.16	.124	94.98	.130	95.74	.136	96.38	.142	96.89
20	Bare	2.010	.....	2.460	.....	3.040	.....	3.740	.....	4.530	.....
	St'd	.257	87.21	.271	88.98	.289	90.49	.306	91.81	.320	92.93
	1½	.257	87.21	.271	88.98	.289	90.49	.306	91.81	.320	92.93
	D. St'd	.144	92.83	.154	93.73	.163	94.63	.173	95.38	.182	95.98
	2	.201	90.00	.213	91.34	.228	92.50	.237	93.66	.250	94.48
	2½	.170	91.58	.179	92.72	.191	93.71	.200	94.65	.210	95.36
	3	.144	92.83	.154	93.73	.163	94.63	.173	95.38	.182	95.98
	3½	.131	93.48	.137	94.43	.143	95.29	.149	96.01	.154	96.60
	4	.116	94.22	.121	95.08	.127	95.82	.132	96.47	.138	96.95

FOR INTERMEDIATE TEMPERATURES

To obtain the values for other temperatures between those given in the table, interpolate, or proportion, the differences between the values for the temperatures given.

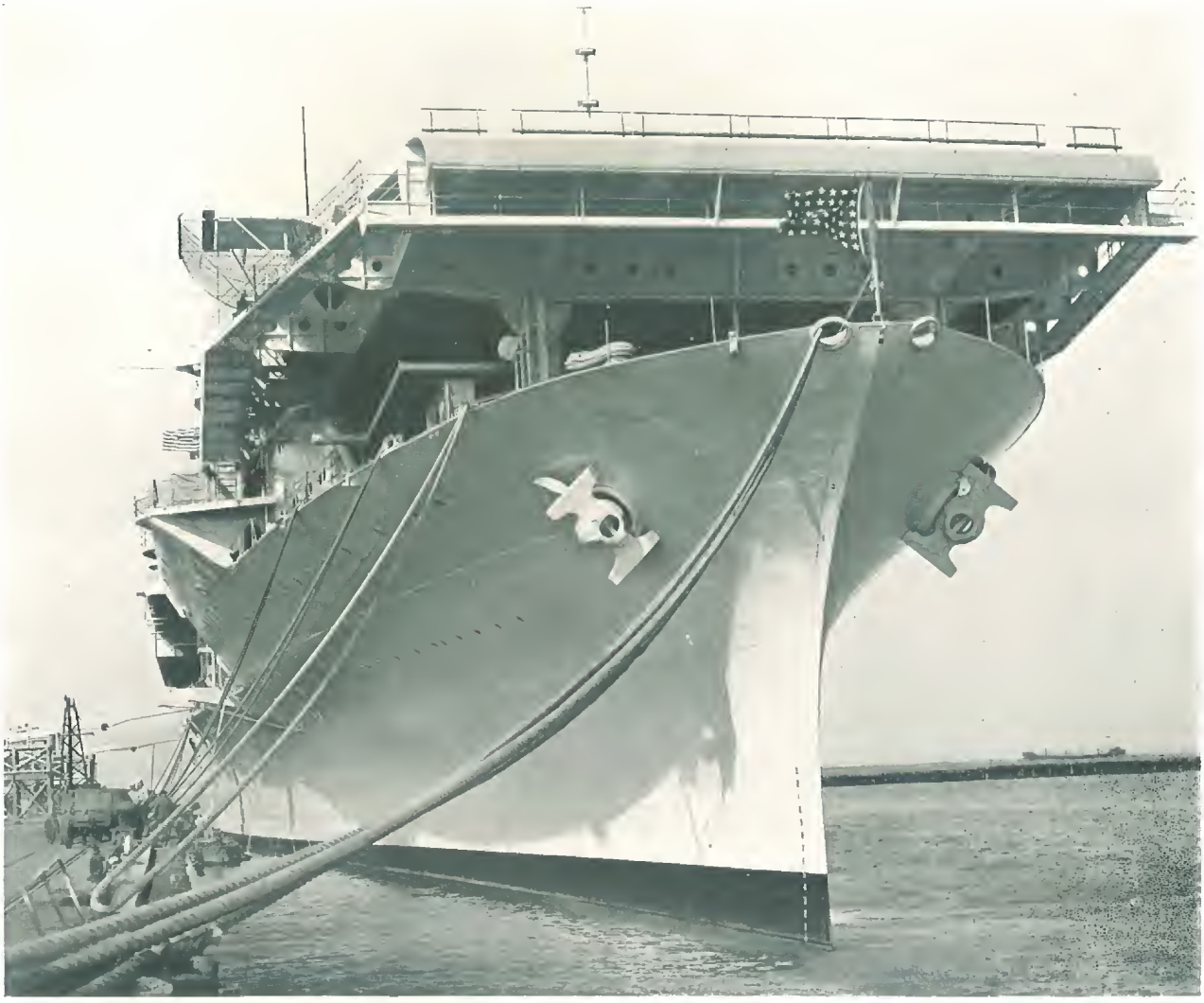
Example:—To find the heat loss and efficiency of 4″ thick 85% Magnesia on 20″ pipe at 450° F. Temperature Difference.

Heat loss at 500° F. is..... .138 B. T. U.
Heat loss at 400° F. is..... .132 B. T. U.
The difference is..... .006

Divide by 100 and multiply by 50. The result is .003. Adding .003 to .132 gives .135 B. T. U. as the heat loss at 450° F. Temperature Difference.

Efficiency at 500° F. is..... 96.95%
Efficiency at 400° F. is..... 96.47%
The difference is..... .48

Divide by 100 and multiply by 50. The result is .24. Adding .24 to 96.47% gives 96.71% as the efficiency at 450° F. Temperature Difference.



A FIGHTING FRONT . . . *backed by*

EHRET INSULATIONS

The U. S. Aircraft Carrier YORKTOWN, shown above, was recently completed by the Newport News Shipbuilding and Drydock Co. Ehret insulations were used on this highly efficient fighting unit.

The U. S. S. INDIANAPOLIS, pictured at the left, and the Aircraft Carriers RANGER and ENTERPRISE are but a few of the more recent ships that use Ehret insulations for economy of operation and heat-loss protection.

Printed in U, S. A. 11-39

EHRET
INSULATIONS

EHRET'S 85% MAGNESIA PIPE COVERING

. . . INSIDE *the Cities Service Building in New York City - - a typical example of modern pump room insulating practice*

. . . and

OUTSIDE

where snow and rain have little effect upon long steam lines at a Crew Levick plant.

EHRET'S 85% MAGNESIA BLOCKS, LAGGING AND CEMENT . . .

Flat Blocks

Ehret's 85% Magnesia is furnished in flat blocks, standard widths being 3", 6" and 12", and standard lengths, 18" and 36". The blocks weigh approximately 1.25 pounds per square foot per 1" of thickness.

Regular thicknesses of 85% Magnesia Blocks are from 1" up to and including 4", in ⅛" increments. Blocks of 12" width will not be furnished less than 1½" in thickness.

Curved Blocks

85% Magnesia can be furnished in curved blocks in the same sizes as flat block, with a minimum thickness of 1¼". The maximum thickness is that which can be cut from a 4" thick flat block. The radius of curvature which the block must fit, should be specified on any order placed for curved blocks.

Locomotive Lagging

The use of 85% Magnesia lagging on locomotive boilers, is standard practice. Ehret's 85% Magnesia lagging is available in flat and curved blocks of standard sizes, as well as special shapes or sizes to fit exactly the locomotive boiler shells.

When lagging is supplied, wire attachment hooks are provided. These hooks not only facilitate the attachment of lagging blocks but also permit the removal of one or more blocks, where necessary, without disturbing adjacent sections.

Special Sizes and Shapes

Ehret's 85% Magnesia can be supplied, when requested, in special sizes and shapes up to 40" long, 12" wide, and from ⅜" to 1" thick. Blocks or lagging, either flat or curved, can be made in special shapes such as tapered forms, wedges, etc., to fit unusual shaped equipment. Dimensions desired, or drawings of the equipment to be covered, are required for designing special shapes.

85% Magnesia Cement

Consisting of exactly the same material as the standard molded forms, 85% Magnesia Cement is of a light, loose, fluffy character, and needs only to be mixed with water to make a plastic cement that, when properly applied and trowelled down, will become firm when dry. Due to its great covering capacity, Ehret's 85% Magnesia Cement is more economical than any other type of insulating cement.

Ehret's 85% Magnesia Cement is used as a sealing coat for application over 85% Magnesia blocks and lagging, and as a means of insulating certain fittings and other odd shaped equipment that do not lend themselves to the use of molded forms.

For best results, 85% Magnesia Cement should be applied in several layers, rather than in one thick layer. This permits the proper drying of each layer and lessens the chance of cracks opening up during the drying process.

Packed in bags of 60 pounds each, Ehret's 85% Magnesia Cement will cover approximately 40 square feet, 1 inch thick, per bag.

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EHRET'S 85% MAGNESIA BLOCK INSULATION

EFFICIENCIES AND B.T.U. LOSSES / SQ. FT. / HOUR / DEGREE TEMP. DIFF. BETWEEN METAL AND AIR

Temperature Hot Surface	170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference	100° F.		200° F.		300° F.		400° F.		500° F.	
Thickness of Block	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
Bare Surface	1.920	——	2.350	——	2.900	——	3.560	——	4.320	——
Ehret's 85% Magnesia Block, only.										
1 Inch	.340	82.29	.357	84.81	.375	87.07	.392	89.00	.410	90.51
1½ "	.236	87.71	.250	89.36	.264	90.90	.278	92.20	.292	93.24
2 "	.185	90.37	.195	91.70	.206	92.90	.217	93.91	.228	94.72
2½ "	.151	92.14	.160	93.19	.169	94.18	.178	95.01	.187	95.67
3 "	.128	93.34	.135	94.25	.142	95.11	.149	95.82	.157	96.36
3½ "	.114	94.07	.120	94.89	.126	95.66	.133	96.27	.139	96.78
4 "	.104	94.59	.109	95.36	.114	96.07	.120	96.64	.126	97.08
With ½" of 85% Magnesia Cement and Canvas Finish.										
1 Inch	.243	87.35	.257	89.06	.270	90.69	.285	92.00	.303	92.99
1½ "	.190	90.11	.200	91.49	.211	92.72	.223	93.74	.234	94.59
2 "	.155	91.93	.164	93.02	.172	94.07	.181	94.92	.191	95.59
2½ "	.131	93.18	.138	94.13	.145	95.00	.153	95.71	.161	96.27
3 "	.120	93.75	.125	94.68	.131	95.48	.136	96.19	.142	96.72
3½ "	.107	94.43	.112	95.23	.117	95.98	.122	96.58	.128	97.04
4 "	.098	94.89	.102	95.66	.106	96.34	.110	96.92	.114	97.36
With ½" of #150 Hard Finish Asbestos Cement.										
1 Inch	.258	86.56	.273	88.38	.295	89.83	.307	91.38	.318	92.63
1½ "	.200	89.58	.211	91.02	.223	92.31	.235	93.40	.243	94.36
2 "	.162	91.56	.171	92.72	.180	93.79	.190	94.66	.197	95.44
2½ "	.135	92.96	.142	93.95	.150	94.82	.158	95.56	.165	96.18
3 "	.122	93.64	.128	94.55	.134	95.37	.140	96.07	.145	96.63
3½ "	.110	94.26	.115	95.10	.120	95.85	.126	96.46	.131	96.95
4 "	.100	94.79	.104	95.57	.108	96.27	.112	96.85	.116	97.29
With ½" of #200 Asbestos Cement and Canvas Finish.										
1 Inch	.282	85.31	.309	86.85	.336	88.41	.363	89.81	.390	90.97
1½ "	.216	88.75	.228	90.30	.240	91.72	.253	92.90	.281	93.49
2 "	.172	91.03	.181	92.30	.192	93.38	.206	94.22	.220	95.00
2½ "	.141	92.65	.149	93.66	.158	94.55	.167	95.32	.179	95.86
3 "	.125	93.48	.132	94.38	.139	95.21	.147	95.88	.156	96.38
3½ "	.112	94.16	.118	94.98	.124	95.73	.131	96.33	.137	96.82
4 "	.102	94.68	.107	95.46	.112	96.14	.119	96.67	.123	97.14

PACKAGING DATA—Ehret's 85% Magnesia Blocks and Lagging

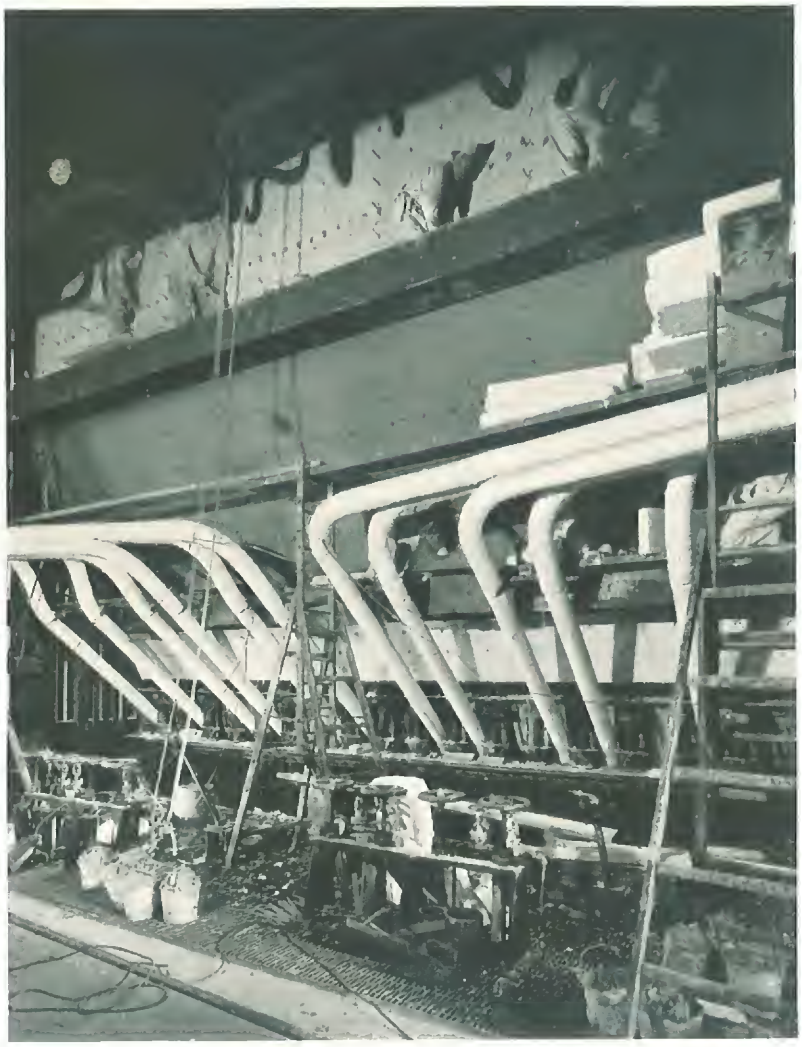
NUMBER OF PIECES IN STANDARD SHIPPING CARTONS AND CASES
(based on block 6" x 36" in size. For other sizes, see conversion figures in Note below).

THICKNESS	CARTONS		CASES		THICKNESS	CARTONS		CASES	
	No. of Pieces	Total sq. ft.	No. of Pieces	Total sq. ft.		No. of Pieces	Total sq. ft.	No. of Pieces	Total sq. ft.
⅜"	64	96	256	384	2"	12	18	48	72
½"	48	72	192	288	2⅛"	10	15	44	66
¾"	30	45	128	192	2¼"	10	15	44	66
⅞"	26	39	108	162	2⅜"	10	15	40	60
1"	24	36	96	144	2½"	8	12	38	57
1⅛"	21	31.5	84	126	2⅝"	8	12	36	54
1¼"	20	30	76	114	2¾"	8	12	32	48
1⅜"	18	27	68	102	2⅞"	8	12	32	48
1½"	16	24	64	96	3"	8	12	32	48
1⅝"	15	22.5	56	84	3¼"	6	9	28	42
1¾"	14	21	56	84	3½"	6	9	24	36
1⅞"	12	18	52	78	4"	6	9	24	36

NOTE:—For blocks 6" x 18", multiply No. of pieces, as given in table, by **2.**
For blocks 3" x 18", multiply No. of pieces, as given in table, by **4.**
For blocks 3" x 36", multiply No. of pieces, as given in table, by **2.**
For blocks 12" x 36", multiply No. of pieces, as given in table, by ½.
For blocks 12" x 18", use figure in table.

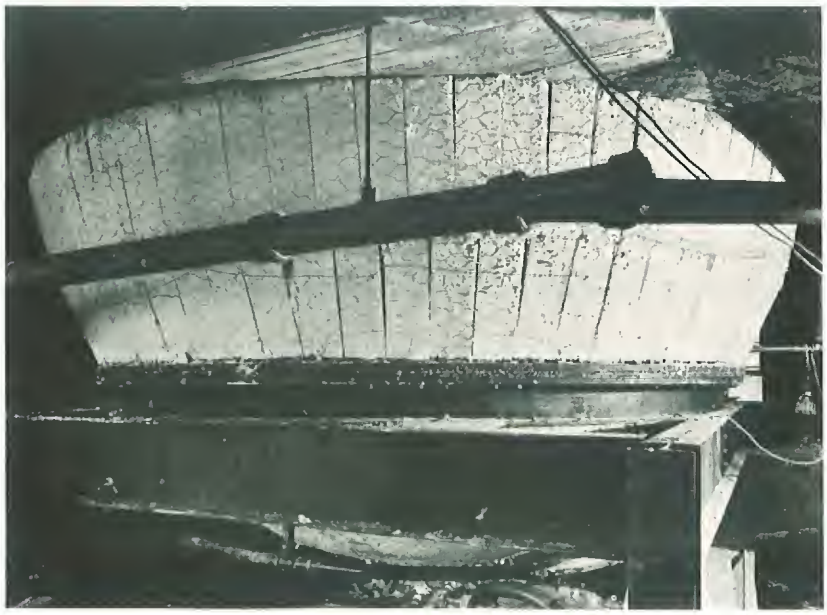
Standard Cartons—approximate gross weight 50 lbs.

Standard Cases—approximate gross weight 220 lbs.



EHRET'S 85% MAGNESIA BLOCKS ON BOILERS . . .

being installed at the Richmond Station of the Philadelphia Electric Company.



. . . and

BREW KETTLES

showing the first step in the application of block insulation at the Esslinger Brewery.

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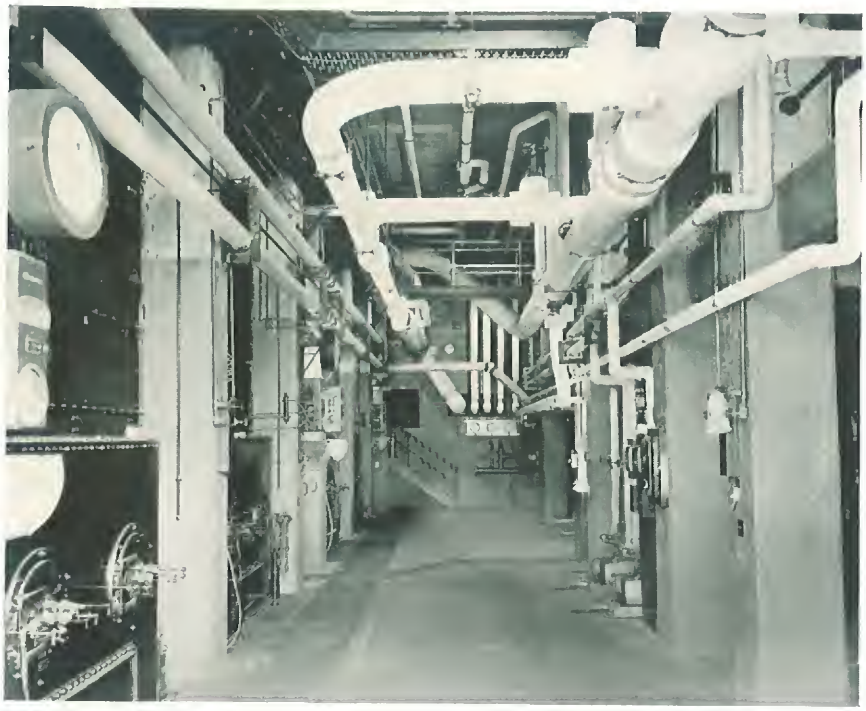
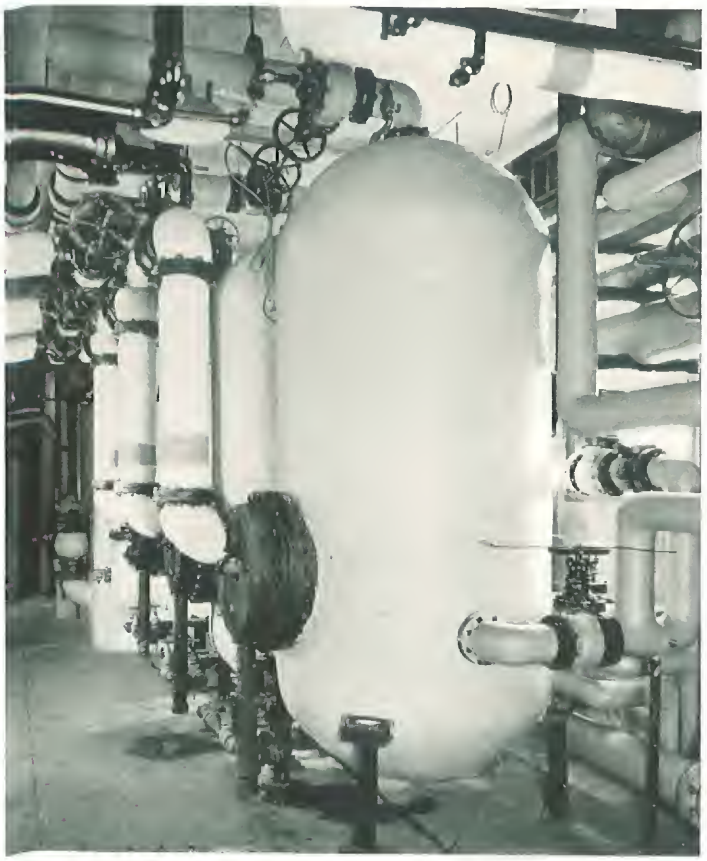
EHRET'S 85% MAGNESIA INSULATIONS

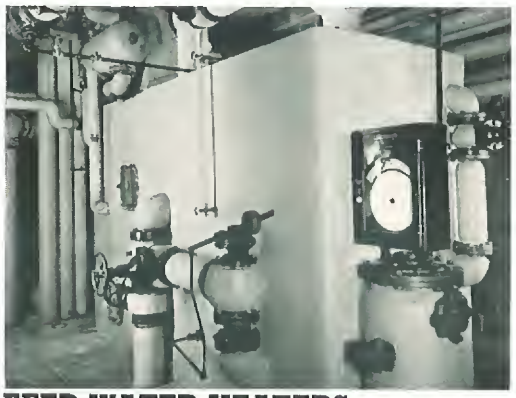
. . . Play their part in caring for Navy veterans at the U. S. Naval Hospital in Philadelphia, Pa.



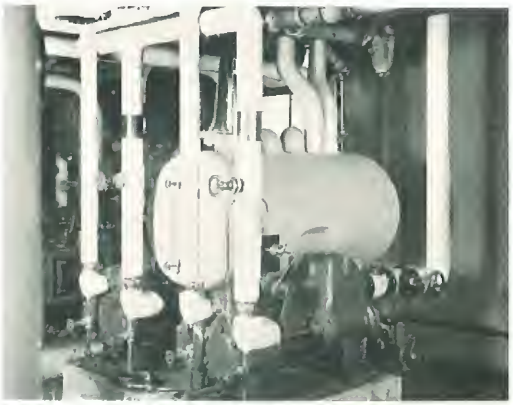
BOILER ROOM *showing main and secondary steam lines in this modern oil-fired installation*



VERTICAL HOT WATER GENERATOR *and steam supply lines all protected with 85% Magnesia*



FEED WATER HEATERS *that are used for main boiler supply*



DUPLEX PUMP AND RECEIVER, *partially uncovered for frequent servicing*

SPECIFICATIONS

FOR EHRET'S 85% MAGNESIA INSULATION

Pipe Coverings, Blocks and Plastic Cement

GENERAL

All pipes and equipment that convey or contain steam, hot water or other heated fluids whose temperatures do not exceed 600°F., shall be insulated with the materials and in the manner herein specified.

MATERIALS

The insulating material supplied and installed under this specification shall be Ehret's 85% Magnesia in molded and plastic cement form. Molded forms, consisting of pipe coverings and blocks, shall be used wherever practicable.

THICKNESSES

The thicknesses applied shall be equal to or greater than those listed in the following table:

MINIMUM THICKNESSES FOR *INDOOR CONDITIONS

TEMPERATURE in degrees F.	PRESSURE in lbs./sq. in.	PIPE SIZES			BLOCKS
		1½" and smaller	2" to 4"	4½" and up	
up to 267	up to 25	Standard	Standard	Standard	1"
268 to 337	26 to 100	Standard	Standard	1½"	1½"
338 to 387	101 to 200	Standard	1½"	2"	2"
388 to 600	over 200	1½"	2"	Double Standard	2½"

*Where the insulation is to be applied on weather-exposed or extremely long lines, or where it is highly desirable to minimize steam condensation, thicknesses shall be at least ½ inch greater than those recommended in the above table.

APPLICATIONS

Pasted-and-Banded Coverings

All sectional coverings shall be carefully fitted to the pipes with side and end joints butted tightly. The side and end laps of factory-weight canvas shall then be pasted down smoothly.

In applying double layer coverings, the inner layer shall be securely wired in place with 16-gauge annealed iron wire. The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the covering. The outer layer shall then be applied with the side and end joints staggered.

After the factory-weight canvas jacket on the outer layer has been smoothly pasted down, factory metal bands shall be applied, two bands for each section of covering. One band shall be placed at the midpoint of each section and one band centered over the joint at the end.

All segmental coverings shall be carefully fitted and applied in a manner similar to that specified for sectional coverings, except that since no factory-weight canvas is attached to the outer surface, all layers shall be wired on in the manner described above for inner layers of double layer coverings. All joints shall be tightly butted together and after being wired in place the joints between segments shall be carefully tapped and rubbed closed with a smooth tool.

Factory-weight canvas jackets shall then be stretched over the surface of the covering and pasted down smoothly with 3-inch laps at all edges. Bands shall then be applied in the manner described above.

Sewed Jackets

Where sewed jackets are desired, the coverings shall be applied in the above described manner except the application of metal bands over the pasted jacket shall be omitted. A layer of 40-pound rosin-sized paper shall be carefully wrapped

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Wound the covering and over this paper there shall be tightly and smoothly stretched a jacket of 8-ounce enamelling duck, which shall be securely and neatly sewed in place. Seams shall be located where least visible.

The general appearance of sewed jacket applications is improved if metal bands are placed on either side of fittings and at terminals such as walls, partitions or bulkheads.

Pipe Coverings to Be Concealed in Walls, Partitions or Floors

Concealed pipe coverings shall be applied in the same manner as described under "Pasted-and-banded Coverings" except the metal bands shall be omitted, and instead each section of covering shall be securely fastened with 3 or more loops of 16-gauge soft copper wire.

Valves and Fittings

All valves and fittings shall be insulated to the same total thickness as the covering on the adjacent piping.

On pipe fittings 4-inch and larger, Ehret's 85% Magnesia Blocks shall be applied allowing for a ½-inch coating of cement. These blocks shall be securely wired in place with 16-gauge annealed iron wire.

For pipe sizes under 4 inches, an all-cement insulation may be used instead of the block and cement finish. The cement shall be Ehret's 85% Magnesia Cement applied in two or more layers according to the total thickness. Each layer of cement shall be permitted to dry before the next is applied. The outer surface shall be trowelled smooth. All valve bonnets shall be insulated up to the stuffing boxes.

The outer surface of insulation on valves and fittings shall be finished with pasted-on factory-weight canvas jackets, or

(Alternate) Where the adjacent coverings have a sewed jacket, the factory-weight canvas need not be applied. The sewed jacket shall be extended to include valves and fittings, or

(Alternate) Where a hard finish is desired, the outer layer of cement shall consist of Ehret's No. 150 Asbestos Cement trowelled to a firm and smooth surface.

Flanges

At flanges, the pipe coverings shall be terminated and beveled off at sufficient distances to permit removal of the flange bolts. Both removable and non-removable insulation coverings for flanges are described on a separate data sheet.

Weatherproofing

All insulation on outdoor piping shall be thoroughly weatherproofed. The sewed jacket should be omitted and in its stead a weatherproofing jacket of Ehret's 50-pound asphalt saturated-and-coated roofing felt shall be applied. The weather proofing jacket shall be closely wrapped over the insulation with 3-inch laps at all edges and with all laps sealed with a waterproof, sealing compound. On horizontal pipes the longitudinal lap shall be placed at the side of the pipe with the lap turned downward to shed water. On vertical sections of the pipe the weatherproofing shall be lapped downward.

Separate loops of 16-gauge Copperweld wire shall then be firmly fastened around the weather proofing at spacings of not more than 6 inches. The ends of the wire loops shall be carefully twisted tight with pliers and turned over to avoid projections, care being taken not to puncture the weatherproofing.

Block Insulation

Blocks shall be secured by means of 16-gauge wire or ⅛-inch wire cables wrapped around or attached to available anchorages. After which, hexagonal mesh galvanized wire netting shall be tightly stretched over the entire surface and securely fastened down.

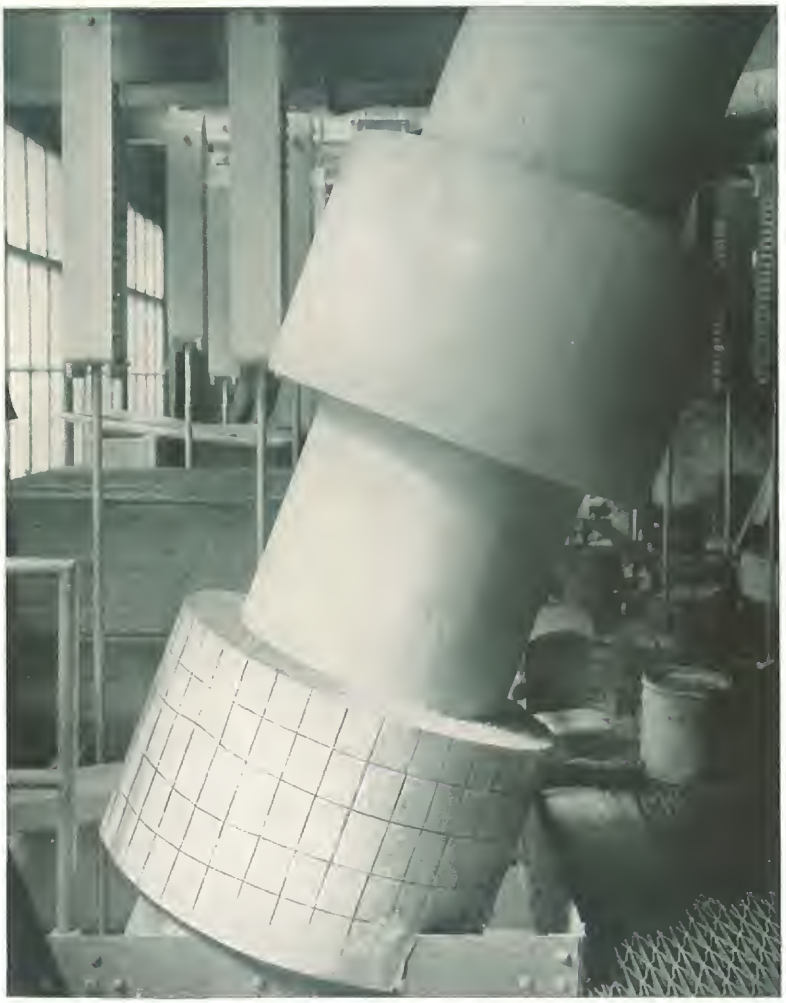
Where more than 2 inches of thickness of 85% Magnesia Block is to be used, blocks shall be applied in two or more layers with joints staggered.

A cement finish shall then be applied. This finish shall consist of Ehret's No. 150 Asbestos Cement, applied in two layers of at least ¼" thickness each.

(Alternate) when an extremely hard finish is desired, the outer layer shall contain from ⅓ to ½, by weight, of portland cement.

Weatherproofing Block Insulation

Where block insulation is to be protected, Ehret's Fibrekote shall be applied in successive layers to the desired thickness.



An 18″ reheater inlet pipe insulated with Ehret's Enduro Block, 2″ thick, and Ehret's 85% Magnesia Block of the same thickness.

EHRET'S ENDURO

FOR TEMPERATURES FROM 600° TO 2000° F.

Ehret's Enduro is a thoroughly practical and highly satisfactory insulating material for use on piping and equipment in the high temperature classification. Many years of service under a wide variety of conditions have proven Enduro to be a trustworthy product for use either alone or in combination with other insulating materials such as Ehret's 85% Magnesia.

The materials of which Enduro is composed are all inorganic. They consist of specially selected precalcined diatomaceous earth, carefully graded long asbestos fibres and suitable bonding materials. Enduro is available as accurately machined sectional and segmental pipe coverings, flat and curved blocks and in loose form which, when mixed with water, makes a plastic cement.

Among the many desirable physical properties and characteristics which have, over the years, contributed to Enduro's success as a high temperature insulation, are the following:

High Thermal Efficiency

Ehret's Enduro has a high thermal efficiency when first applied, and it maintains its efficiency indefinately. Test samples of Enduro taken from applications that have had years of rigorous high temperature service, show no loss in insulating efficiency.

High Mechanical Strength

Resistance to damage in shipping and handling, as well as its ability to withstand vibration and normal service abuses, account for savings in installation costs and low maintenance expense.

Workability

Pipe coverings and blocks are easily cut, fitted and applied. Enduro plastic cement mixes, works and trowells well and it can be made from either the loose Enduro or ground up scraps of the molded forms. There need be no waste, and the materials may be removed and reapplied with a minimum of effort and expense.

Low Shrinkage

Enduro pipe coverings and blocks are molded, dried and then accurately machined to size in the process of manufacture. Because the diatomaceous earth is calcined before the material is molded, shrinkage in service is negligible.

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Affected by Moisture

Exposure to conditions of moisture causes no deterioration. Total immersion in water, for even long periods of time, have no harmful effect. Enduro that has been water-soaked can be dried out without removing it from the piping or equipment, and returned to service conditions with no change in its original characteristics.

Low Cost

When the applied cost of Enduro is distributed over its long service life, its yearly cost is low. Ease in handling and simplicity of application keep labor costs at a satisfactory minimum.

ENDURO–85% MAGNESIA COMBINATION INSULATION

Although Enduro has a high thermal efficiency, the efficiency of 85% Magnesia is still greater. Because of the additional savings made possible by the use of 85% Magnesia, high temperature insulation applications nearly always consist of the two materials in combination. The Enduro is applied first as an inner layer, and the thickness used is such that, when covered with a layer of 85% Magnesia, the temperature at the inner surface of the 85% Magnesia will be less than 600° F.

COMPOSITE TEST DATA

EHRET'S ENDURO MOLDED INSULATION

Soaking Temperatures for 6 Hours	Loss in Weight	Lineal Shrinkage	Plastometer Penetration 1/8" Ball Point 1/100 m. m.	Breaking Load 6" Wide on 10" Centers		Modulus of Rupture 6" Wide on 10" Centers	
				1½" Thick	2" Thick	1½" Thick	2" Thick
Before Heating	.....	.....	68	56 lbs.	77 lbs.	62	48
700° F.	3.9%	.01%	70	54 lbs.	75 lbs.	60	47
750° F.	4.3%	.02%	71	52 lbs.	72 lbs.	58	45
800° F.	5.5%	.03%	71.5	51 lbs.	69 lbs.	57	43
900° F.	6.4%	.04%	71.5	51 lbs.	69 lbs.	57	43
1000° F.	7.0%	.05%	71.5	51 lbs.	69 lbs.	57	43
1200° F.	8.3%	.40%	71.5	51 lbs.	69 lbs.	57	43
1400° F.	8.4%	.75%	72.5	52 lbs.	72 lbs.	58	45
1600° F.	8.4%	.84%	70	53 lbs.	73 lbs.	59	46
1800° F.	8.5%	.91%	65.5	55 lbs.	76 lbs.	61	48
2000° F.	8.5%	.91%	60	60 lbs.	83 lbs.	67	52

Compressive Strength

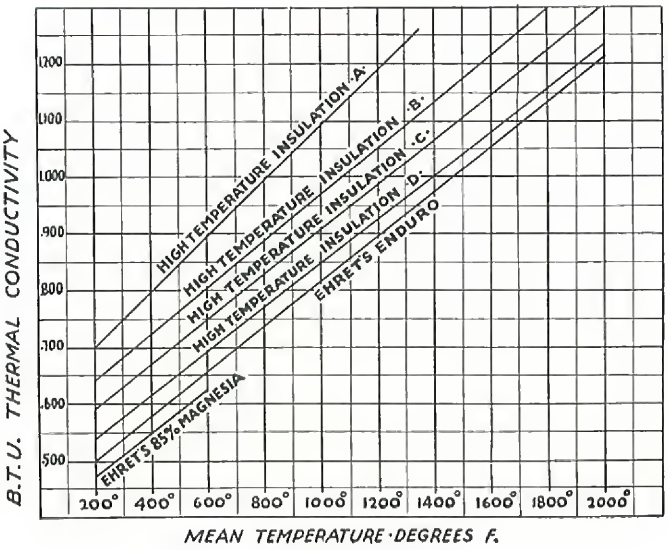
The ability to withstand compressive stress is highly desirable in any insulating material. Ehret's Enduro has high compressive strength and consequently is not likely to be damaged by normal service abuses such as being walked on by workmen or bumped with tools or other heavy objects.

In laboratory tests, a load was applied to a block of Ehret's Enduro, 2" thick. When this load was built up to a pressure of 90 lbs. per square inch, the total reduction in thickness measured only .0625 inch. As the loading was increased beyond this point, there was a gradual decrease in thickness, but at no time did the Enduro collapse.

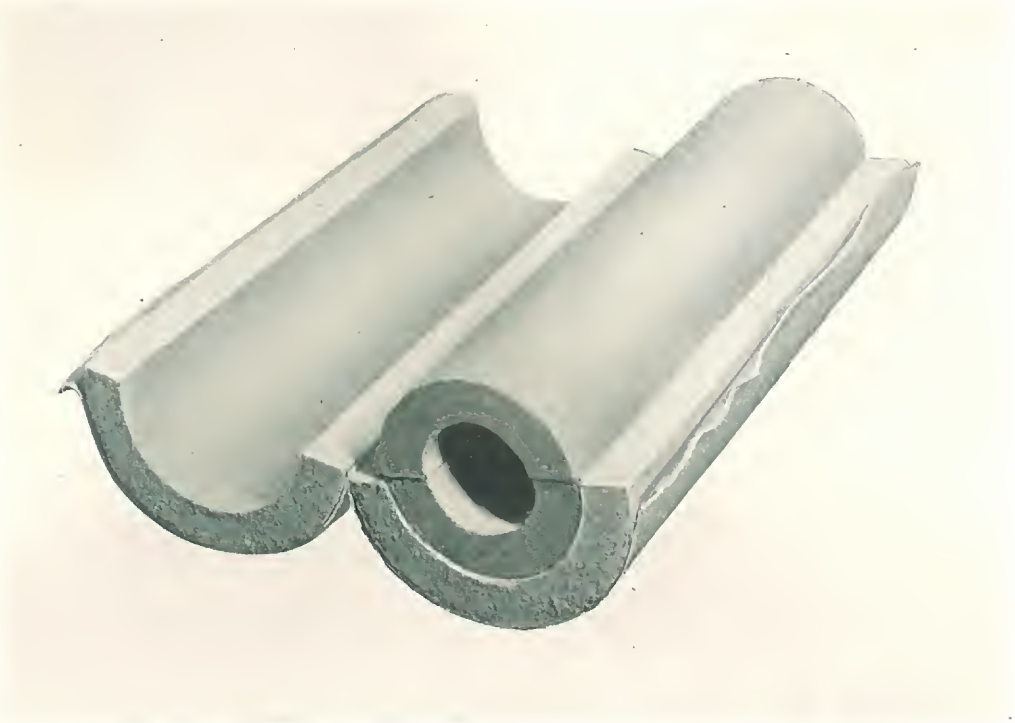
Water Absorption

Typical samples of Ehret's Enduro taken from stock were used in a laboratory test for water absorption characteristics. After submersion for two hours, the samples were weighed and showed 188% increase over the original weight.

Comparative Conductivities of Various Heat Insulations with Enduro



FOR TEMPERATURES ABOVE 600° F.



EHRET'S ENDURO PIPE INSULATION

and ENDURO–85% MAGNESIA COMBINATION COVERINGS

Ehret's Enduro is an ideal material for use on pipes whose temperatures exceed 600° F. It is made in single and multiple-layer pipe covering and in both sectional and segmental forms.

Double layer coverings for this high temperature field are widely used in the form of combination insulation, consisting of an inner layer of Ehret's Enduro and an outer layer of Ehret's 85% Magnesia. The reasons for the use of this combination insulation are explained on Data Sheet No. 113.

LENGTHS

All Enduro and Combination Pipe Coverings are furnished in standard 3-foot lengths.

THICKNESSES

Thicknesses of both Enduro and Combination Pipe Coverings will be found listed in the tables of Efficiencies and Heat Losses on Ehret Data Sheets Nos. 115 and 116. If thicknesses other than those listed are required, they can usually be furnished.

AVAILABLE FORMS

Ehret's Enduro Pipe Coverings are available in either sectional (semi-circular) or segmental forms, depending upon the pipe size and insulation thickness as noted in the accompanying table.

The outer surfaces of single and double-layer sectional coverings are provided with attached regulation canvas jackets and metal bands. For segmental coverings, canvas jackets and bands are available at slight additional cost.

WEATHERPROOFING JACKETS

When desired, weatherproofing jackets can be furnished for Enduro and Combination Pipe Coverings. Jackets are available as an integral part of the pipe covering and shipped from the factory as such, or the jackets may be furnished separately in cut or roll form and applied on the insulation after it has been installed. Recommendations of various types of weatherproofing jackets are described on Data Sheets Nos. 120 and 421.

Available Forms of Enduro, 85% Magnesia and Combination Pipe Insulation

SINGLE-LAYER COVERINGS (or Inner Layer of Double-Layer Coverings)		
Thickness of Covering	Pipe Sizes	Form
Up to 2″ inclusive	Up to 11″ inclusive	Sectional
Up to 2″ inclusive	12″	Segmental*
Up to 2″ inclusive	Over 12″	Segmental
2½″	Up to 10″ inclusive	Sectional
2½″	Over 10″	Segmental
* Can be furnished sectional on special order.		
OUTER LAYER OF DOUBLE-LAYER COVERINGS		
Up to 2″ inclusive	Up to 8″ inclusive	Sectional
Up to 2″ inclusive	Over 8″	Segmental
2½″	Up to 7″ inclusive	Sectional
2½″	Over 7″	Segmental

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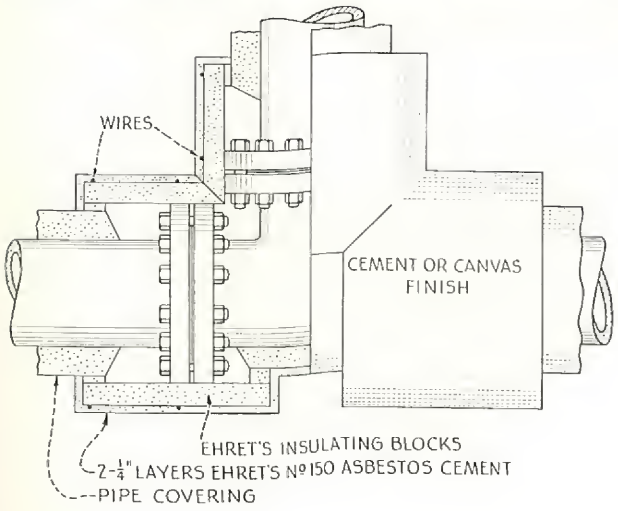
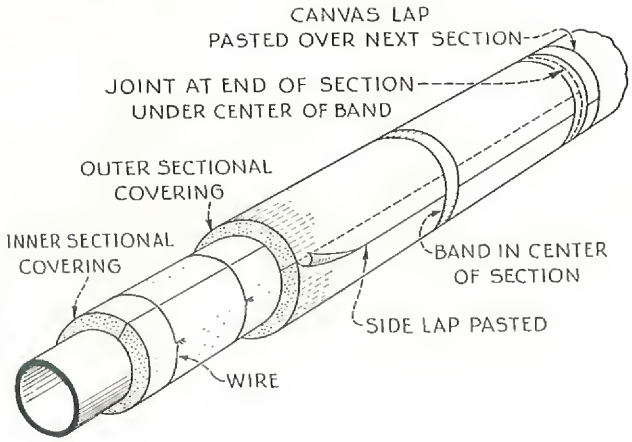
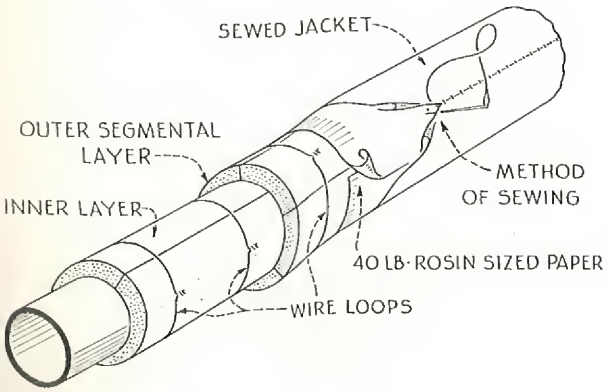
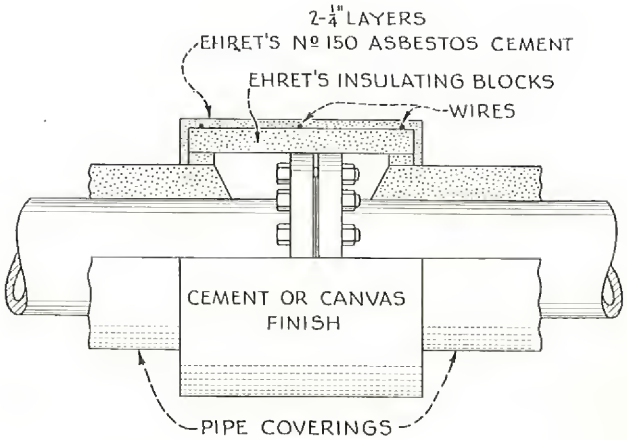
The neatly finished boiler-room job shown at the right includes pipe coverings of Ehret's Enduro-85% Magnesia Combination, while fittings and valves are protected with blocks and plastic cement of the same materials. Pasted canvas jackets are painted white for finish.

TYPICAL ENDURO APPLICATION DETAILS . . .









EHRET INSULATIONS

Ehret's Enduro — 85% Magnesia Combination Pipe Insulation

EFFICIENCIES and HEAT LOSSES

BTU Losses per Square Foot of Pipe Surface per Hour per Degree temperature difference between pipe and air

Pipe Temperature			570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.	
Temperature Difference			500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.	
Pipe Size	Thickness Enduro	Thickness 85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
½"	Bare		5.410		6.310		7.250		8.220		9.230		10.200	
	1½"		.816	84.84	.842	86.65	.868	88.02	.895	89.19	.922	90.00	.950	90.70
	2"		.702	87.02	.731	88.41	.760	89.51	.785	90.37	.812	91.20	.840	91.76
¾"	Bare		5.250		6.150		7.090		8.060		9.070		10.400	
	1½"		.730	86.01	.756	87.70	.782	88.97	.808	89.95	.835	90.80	.862	91.71
	2"		.632	87.96	.656	89.33	.678	90.43	.700	91.39	.723	92.03	.746	92.82
1"	Bare		5.160		6.050		6.980		7.950		8.960		9.930	
	1½"		.655	87.30	.675	88.84	.697	90.01	.714	91.00	.734	91.82	.754	92.41
	2"		.565	89.05	.587	90.29	.612	91.23	.630	92.17	.652	92.72	.674	93.21
	2½"		.510	90.11	.533	91.19	.556	92.03	.580	92.71	.603	93.39	.626	93.70
1¼"	Bare		5.090		5.980		6.910		7.880		8.890		9.860	
	1½"		.601	88.15	.619	89.64	.635	90.81	.655	91.69	.673	92.42	.691	93.00
	2"		.514	89.90	.528	91.17	.540	92.17	.555	92.97	.570	93.58	.584	94.18
	2½"		.458	91.00	.483	91.92	.508	92.65	.534	93.22	.559	93.71	.570	94.22
1½"	Bare		5.030		5.920		6.860		7.830		8.840		9.810	
	1½"		.571	88.64	.585	90.12	.601	91.23	.618	92.30	.633	92.84	.648	93.40
	2"		.484	90.57	.500	91.50	.517	92.60	.530	93.40	.545	93.83	.560	94.30
	2½"		.428	91.48	.448	92.43	.468	93.18	.488	93.77	.508	94.25	.528	94.62
2"	Bare		4.980		5.840		6.770		7.740		8.760		9.730	
	1¼"	Standard	.374	92.49	.388	93.34	.402	94.21	.414	94.65				
	1¼"	1½"	.338	93.21	.352	93.97	.365	94.60	.378	95.12				
	1¼"	2"	.307	93.83	.319	94.53	.332	95.09						
	1¼"	2½"	.288	94.21	.300	94.82	.313	95.37						
	1¼"	3"	.274	94.49	.286	95.07	.296	95.63						
	2"	Standard	.326	93.25	.340	94.18	.355	94.91	.371	95.20	.386	95.60		
	2"	1½"	.312	93.73	.326	94.42	.340	95.00	.352	95.45				
	2"	2"	.292	94.13	.304	94.79	.317	95.31	.332	95.70				
	2"	2½"	.278	94.46	.288	95.04	.299	95.58						
	2"	3"	.264	94.70	.275	95.26	.287	95.76						
	2½"	Standard	.301	93.92	.316	94.55	.329	95.14	.342	95.60	.355	95.85		
	2½"	1½"	.294	94.06	.308	94.69	.322	95.24	.335	95.70	.349	96.02		
	2½"	2"	.280	94.38	.290	95.01	.301	95.55	.313	95.98				
	2½"	2½"	.268	94.62	.279	95.20	.290	95.72	.301	96.14				
	2½"	3"	.261	94.76	.271	95.33	.281	95.85						
2½"	Bare		4.910		5.780		6.710		7.680		8.710		9.690	
	1 1/16"	Standard	.350	92.88	.364	93.70	.378	94.38	.392	94.90				
	1 1/16"	1½"	.312	93.64	.326	94.36	.340	94.93	.354	95.39				
	1 1/16"	2"	.284	94.21	.296	94.88	.309	95.38						
	1 1/16"	2½"	.265	94.60	.277	95.20	.290	95.67						
	1 1/16"	3"	.251	94.88	.263	95.45	.272	95.95						
	2"	Standard	.301	93.89	.313	94.57	.325	95.17	.336	95.63	.348	96.01		
	2"	1½"	.287	94.18	.301	94.78	.315	95.31	.329	95.72				
	2"	2"	.268	94.54	.280	95.16	.292	95.64	.304	96.05				
	2"	2½"	.255	94.84	.267	95.42	.276	95.89						
	2"	3"	.245	95.01	.257	95.55	.267	96.02						
	2½"	Standard	.278	94.31	.291	94.94	.305	95.47	.317	95.87	.331	96.21		
	2½"	1½"	.271	94.46	.284	95.06	.297	95.59	.309	95.98	.322	96.31		
	2½"	2"	.257	94.74	.269	95.35	.281	95.82	.292	96.20				
	2½"	2½"	.248	94.95	.259	95.52	.269	96.00	.279	96.36				
	2½"	3"	.238	95.15	.248	95.71	.259	96.14						
3"	Bare		4.850		5.710		6.660		7.630		8.660		9.630	
	1 1/16"	Standard	.330	93.18	.344	93.97	.358	94.63	.378	95.05				
	1 1/16"	1½"	.291	94.00	.303	94.70	.315	95.27	.327	95.72				
	1 1/16"	2"	.264	94.56	.276	95.17	.290	95.64						
	1 1/16"	2½"	.247	94.90	.259	95.47	.271	95.93						
	1 1/16"	3"	.233	95.19	.244	95.73	.255	96.17						
	2"	Standard	.280	94.23	.292	94.88	.304	95.43	.316	95.86	.328	96.21		
	2"	1½"	.269	94.45	.282	95.05	.294	95.59	.307	95.97				
	2"	2"	.250	94.84	.262	95.42	.274	95.88	.287	96.23				
	2"	2½"	.237	95.11	.248	95.66	.259	96.11						
	2"	3"	.227	95.32	.238	95.83	.249	96.29						
	2½"	Standard	.260	94.63	.273	95.22	.287	95.72	.298	96.09	.311	96.42		
	2½"	1½"	.253	94.78	.266	95.34	.279	95.84	.292	96.17	.305	96.50		
	2½"	2"	.240	95.05	.251	95.61	.262	96.09	.274	96.41				
	2½"	2½"	.229	95.28	.240	95.80	.251	96.26	.262	96.56				
	2½"	3"	.220	95.46	.231	95.95	.242	96.40						

Printed in U. S. A. 9-38

EHRET
INSULATIONS

Ehret's Enduro — 85% Magnesia Combination Pipe Insulation

EFFICIENCIES and HEAT LOSSES

BTU Losses per Square Foot of Pipe Surface per Hour per Degree temperature difference between pipe and air

Pipe Temperature			570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.	
Temperature Difference			500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.	
Pipe Size	Thickness Enduro	Thickness 85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU oss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
3½"	Bare	.....	4.800	.....	5.670	.....	6.620	.....	7.590	.....	8.620	.....	9.590	.....
	1 1/16"	Standard	.314	93.45	.327	94.23	.340	94.86	.354	95.34				
	1 1/16"	1½"	.277	94.23	.288	94.92	.300	95.49	.311	95.91				
	1 1/16"	2"	.250	94.79	.262	95.38	.274	95.86						
	1 1/16"	2½"	.230	95.21	.242	95.73	.255	96.15						
	1 1/16"	3"	.220	95.42	.230	95.94	.240	96.37						
	2"	Standard	.266	94.46	.277	95.11	.288	95.65	.300	96.05	.311	96.39		
	2"	1½"	.254	94.71	.267	95.29	.280	95.77	.292	96.17				
	2"	2"	.236	95.09	.245	95.69	.258	96.10	.270	96.45				
	2"	2½"	.223	95.36	.233	95.89	.243	96.33						
	2"	3"	.211	95.61	.221	96.11	.231	96.51						
	2½"	Standard	.244	94.81	.258	95.46	.271	95.92	.282	96.29	.294	96.59		
	2½"	1½"	.238	95.05	.251	95.58	.263	96.04	.275	96.38	.287	96.67		
	2½"	2"	.225	95.32	.236	95.85	.247	96.27	.257	96.62				
	2½"	2½"	.213	95.57	.223	96.08	.233	96.48	.242	96.81				
	2½"	3"	.205	95.74	.215	96.22	.225	96.60						
4"	Bare	.....	4.770	.....	5.640	.....	6.580	.....	7.550	.....	8.580	.....	9.550	.....
	1 1/16"	Standard	.300	93.70	.310	94.53	.320	95.13	.329	95.65				
	1 1/16"	1½"	.265	94.45	.275	95.12	.284	95.69	.294	96.11				
	1 1/16"	2"	.234	95.09	.246	95.64	.256	96.11						
	1 1/16"	2½"	.219	95.40	.229	95.93	.239	96.37						
	1 1/16"	3"	.207	95.65	.218	96.13	.227	96.55						
	2"	Standard	.252	94.70	.262	95.37	.272	95.87	.283	96.26	.292	96.60		
	2"	1½"	.239	95.00	.249	95.60	.259	96.07	.271	96.40				
	2"	2"	.222	95.34	.232	95.88	.242	96.32	.253	96.65				
	2"	2½"	.210	95.59	.220	96.10	.230	96.51						
	2"	3"	.199	95.83	.208	96.31	.218	96.69						
	2½"	Standard	.230	95.18	.240	95.73	.251	96.19	.261	96.56	.273	96.81		
	2½"	1½"	.224	95.30	.234	95.84	.245	96.28	.257	96.62	.268	96.88		
	2½"	2"	.213	95.53	.223	96.05	.233	96.47	.243	96.80				
	2½"	2½"	.201	95.78	.211	96.26	.220	96.66	.230	96.97				
	2½"	3"	.193	95.95	.202	96.43	.211	96.80						
4½"	Bare	.....	4.740	.....	5.620	.....	6.540	.....	7.530	.....	8.550	.....	9.520	.....
	1 1/16"	Standard	.270	94.31	.283	94.95	.296	95.47	.310	95.88				
	1 1/16"	1½"	.256	94.60	.266	95.27	.276	95.78	.287	96.18				
	1 1/16"	2"	.229	95.17	.240	95.73	.250	96.33						
	1 1/16"	2½"	.209	95.59	.219	96.11	.230	96.51						
	1 1/16"	3"	.197	95.82	.206	96.33	.215	96.71						
	2"	Standard	.243	94.87	.255	95.64	.268	96.06	.278	96.31	.288	96.65		
	2"	1½"	.232	95.11	.244	95.84	.256	96.24	.268	96.44				
	2"	2"	.215	95.47	.225	96.00	.235	96.41	.246	96.73				
	2"	2½"	.200	95.78	.210	96.26	.220	96.63						
	2"	3"	.189	96.01	.198	96.48	.208	96.82						
	2½"	Standard	.226	95.24	.236	95.80	.247	96.23	.258	96.57	.268	96.87		
	2½"	1½"	.217	95.43	.227	95.96	.237	96.38	.248	96.70	.258	96.98		
	2½"	2"	.203	95.73	.212	96.23	.222	96.61	.232	96.92				
	2½"	2½"	.191	95.98	.200	96.44	.210	96.79	.220	97.08				
	2½"	3"	.184	96.13	.193	96.56	.202	96.92						
	3"	2"	.193	95.94	.202	96.40	.212	96.77	.222	97.05	.232	97.29		
	3"	2½"	.186	96.09	.195	96.53	.204	96.89	.213	97.17				
	3"	3"	.180	96.21	.188	96.65	.196	97.01	.204	97.29				
5"	Bare	.....	4.710	.....	5.600	.....	6.520	.....	7.490	.....	8.520	.....	9.490	.....
	1½"	Standard	.262	94.43	.271	95.15	.280	95.71	.290	96.12				
	1½"	1½"	.250	94.69	.258	95.38	.267	95.89	.278	96.28				
	1½"	2"	.216	95.42	.225	95.98	.234	96.40						
	1½"	2½"	.202	95.72	.212	96.22	.221	96.60						
	1½"	3"	.192	95.93	.201	96.41	.210	96.78						
	2"	Standard	.235	95.00	.245	95.62	.255	96.10	.266	96.45	.273	96.80		
	2"	1½"	.220	95.32	.230	95.88	.240	96.32	.250	96.66				
	2"	2"	.206	95.63	.215	96.16	.225	96.55	.236	96.85				
	2"	2½"	.194	95.97	.203	96.38	.212	96.75						
	2"	3"	.184	96.09	.192	96.58	.200	96.93						
	2½"	Standard	.218	95.37	.228	95.93	.238	96.36	.247	96.71	.257	97.01		
	2½"	1½"	.208	95.59	.218	96.11	.228	96.50	.239	96.81	.249	97.10		
	2½"	2"	.196	95.84	.205	96.34	.214	96.72	.223	97.03				
	2½"	2½"	.186	96.05	.194	96.54	.202	96.90	.209	97.21				
	2½"	3"	.176	96.26	.184	96.72	.192	97.05						
	3"	2"	.188	96.01	.196	96.51	.204	96.87	.211	97.19	.219	97.43		
	3"	2½"	.178	96.22	.186	96.69	.194	97.02	.202	97.31				
	3"	3"	.171	96.37	.179	96.81	.187	97.13	.195	97.40				

Ehret's Enduro — 85% Magnesia Combination Pipe Insulation

EFFICIENCIES and HEAT LOSSES

BTU Losses per Square Foot of Pipe Surface per Hour per Degree temperature difference between pipe and air

Pipe Temperature		570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.	
Temperature Difference		500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.	
Pipe Size	Thickness Enduro / 85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
6"	Bare /	4.690	.....	5.570	.....	6.490	.....	7.460	.....	8.490	.....	9.460	.....
	1½" / Standard	.248	94.70	.258	95.37	.268	95.87	.277	96.28				
	1½" / 1½"	.235	94.99	.244	95.62	.254	96.07	.263	96.47				
	1½" / 2"	.203	95.68	.212	96.20	.222	96.58						
	1½" / 2½"	.190	95.95	.199	96.43	.209	96.78						
	1½" / 3"	.180	96.18	.188	96.63	.196	97.00						
	2" / Standard	.221	95.30	.231	95.85	.241	96.30	.250	96.65	.260	96.94		
	2" / 1½"	.207	95.68	.217	96.10	.227	96.50	.239	96.80	.249	97.07		
	2" / 2"	.194	95.86	.203	96.36	.212	96.72	.222	97.02				
	2" / 2½"	.183	96.10	.192	96.55	.200	96.93						
	2" / 3"	.172	96.33	.179	96.78	.186	97.14						
	2½" / Standard	.196	95.83	.205	96.32	.214	96.71	.224	96.99	.235	97.23		
	2½" / 1½"	.196	95.83	.205	96.32	.214	96.71	.224	96.99	.235	97.23		
	2½" / 2"	.185	96.06	.194	96.52	.202	96.90	.210	97.19				
	2½" / 2½"	.174	96.29	.181	96.75	.188	97.11	.196	97.37				
	2½" / 3"	.163	96.52	.171	96.93	.180	97.23	.188	97.47				
	3" / 2"	.176	96.25	.183	96.71	.190	97.08	.198	97.34	.207	97.56		
	3" / 2½"	.167	96.44	.174	96.88	.182	97.20	.190	97.45				
	3" / 3"	.159	96.61	.167	97.00	.175	97.31	.183	97.54				
8"	Bare /	4.660	.....	5.530	.....	6.460	.....	7.430	.....	8.450	.....	9.420	.....
	1½" / Standard	.219	95.30	.229	95.85	.239	96.30	.248	96.64				
	1½" / 1½"	.219	95.30	.229	95.85	.239	96.30	.248	96.64				
	1½" / 2"	.193	95.87	.201	96.36	.210	96.75						
	1½" / 2½"	.173	96.29	.181	96.73	.190	97.05						
	1½" / 3"	.161	96.54	.171	96.90	.178	97.24						
	2" / Standard	.197	95.78	.206	96.27	.215	96.67	.223	97.00	.230	97.28		
	2" / 1½"	.197	95.78	.206	96.27	.215	96.67	.223	97.00	.230	97.28		
	2" / 2"	.176	96.22	.185	96.66	.193	97.01	.202	97.26				
	2" / 2½"	.165	96.46	.173	96.88	.180	97.21						
	2" / 3"	.155	96.67	.162	97.07	.169	97.38						
	2½" / Standard	.178	96.18	.187	96.62	.195	96.98	.204	97.24	.213	97.48		
	2½" / 1½"	.178	96.18	.187	96.62	.195	96.98	.204	97.24	.213	97.48		
	2½" / 2"	.167	96.41	.175	96.84	.182	97.18	.190	97.44				
	2½" / 2½"	.157	96.63	.164	97.04	.171	97.35	.178	97.61				
	2½" / 3"	.148	96.82	.155	97.20	.162	97.49	.169	97.72				
	3" / 2"	.159	96.59	.166	97.00	.173	97.32	.180	97.58	.187	97.79		
	3" / 2½"	.150	96.78	.157	97.17	.164	97.46	.171	97.70				
	3" / 3"	.142	96.95	.149	97.31	.156	97.58	.163	97.81				
10"	Bare /	4.640	.....	5.500	.....	6.440	.....	7.410	.....	8.410	.....	9.380	.....
	1 9/16" / Standard	.209	95.50	.217	96.05	.225	96.50	.234	96.84				
	1 9/16" / 1½"	.209	95.50	.217	96.05	.225	96.50	.234	96.84				
	1 9/16" / 2"	.177	96.18	.187	96.59	.197	96.93						
	1 9/16" / 2½"	.164	96.47	.172	96.87	.178	97.23						
	1 9/16" / 3"	.153	96.71	.160	97.09	.166	97.42						
	2" / Standard	.181	96.11	.191	96.52	.201	96.87	.211	97.15	.218	97.41		
	2" / 1½"	.181	96.11	.191	96.52	.201	96.87	.211	97.15	.218	97.41		
	2" / 2"	.167	96.40	.174	96.83	.180	97.20	.187	97.47				
	2" / 2½"	.156	96.64	.163	97.04	.170	97.36	.177	97.64				
	2" / 3"	.146	96.85	.153	97.21	.160	97.50						
	2½" / Standard	.169	96.36	.176	96.80	.184	97.13	.193	97.40	.201	97.61		
	2½" / 1½"	.169	96.36	.176	96.80	.184	97.13	.193	97.40	.201	97.61		
	2½" / 2"	.158	96.59	.165	97.00	.172	97.32	.180	97.57	.187	97.78		
	2½" / 2½"	.148	96.81	.155	97.18	.162	97.47	.169	97.72				
	2½" / 3"	.139	97.00	.145	97.36	.152	97.63	.159	97.86				
	3" / 2"	.150	96.76	.157	97.14	.164	97.44	.171	97.69	.178	97.88		
	3" / 2½"	.141	96.96	.148	97.30	.155	97.58	.161	97.83				
	3" / 3"	.133	97.13	.140	97.45	.146	97.72	.152	97.95				
12"	Bare /	4.610	.....	5.480	.....	6.410	.....	7.380	.....	8.390	.....	9.360	.....
	1 9/16" / Standard	.199	95.68	.208	96.20	.218	96.60	.227	96.90				
	1 9/16" / 1½"	.199	95.68	.208	96.20	.218	96.60	.227	96.90				
	1 9/16" / 2"	.172	96.26	.180	96.71	.188	97.07	.197	97.33				
	1 9/16" / 2½"	.157	96.58	.163	97.02	.170	97.35						
	1 9/16" / 3"	.145	96.86	.152	97.23	.158	97.53						
	2" / Standard	.175	96.20	.185	96.63	.195	96.97	.204	97.24	.214	97.45		
	2" / 1½"	.175	96.20	.185	96.63	.195	96.97	.204	97.24	.214	97.45		
	2" / 2"	.161	96.49	.167	96.96	.173	97.30	.179	97.57				
	2" / 2½"	.148	96.79	.154	97.19	.160	97.50	.167	97.74				
	2" / 3"	.137	97.03	.143	97.39	.150	97.65						
	2½" / Standard	.163	96.47	.170	96.90	.176	97.25	.183	97.52	.190	97.73		
	2½" / 1½"	.163	96.47	.170	96.90	.176	97.25	.183	97.52	.190	97.73		
	2½" / 2"	.150	96.75	.156	97.15	.162	97.47	.169	97.71	.176	97.90		
	2½" / 2½"	.139	96.99	.145	97.35	.152	97.62	.158	97.86				
	2½" / 3"	.131	97.16	.137	97.50	.143	97.76	.148	97.99				
	3" / 2"	.142	96.92	.148	97.30	.154	97.59	.160	97.83	.166	98.02		
	3" / 2½"	.133	97.12	.139	97.46	.145	97.73	.151	97.95				
	3" / 3"	.126	97.27	.132	97.59	.138	97.84	.143	98.06				

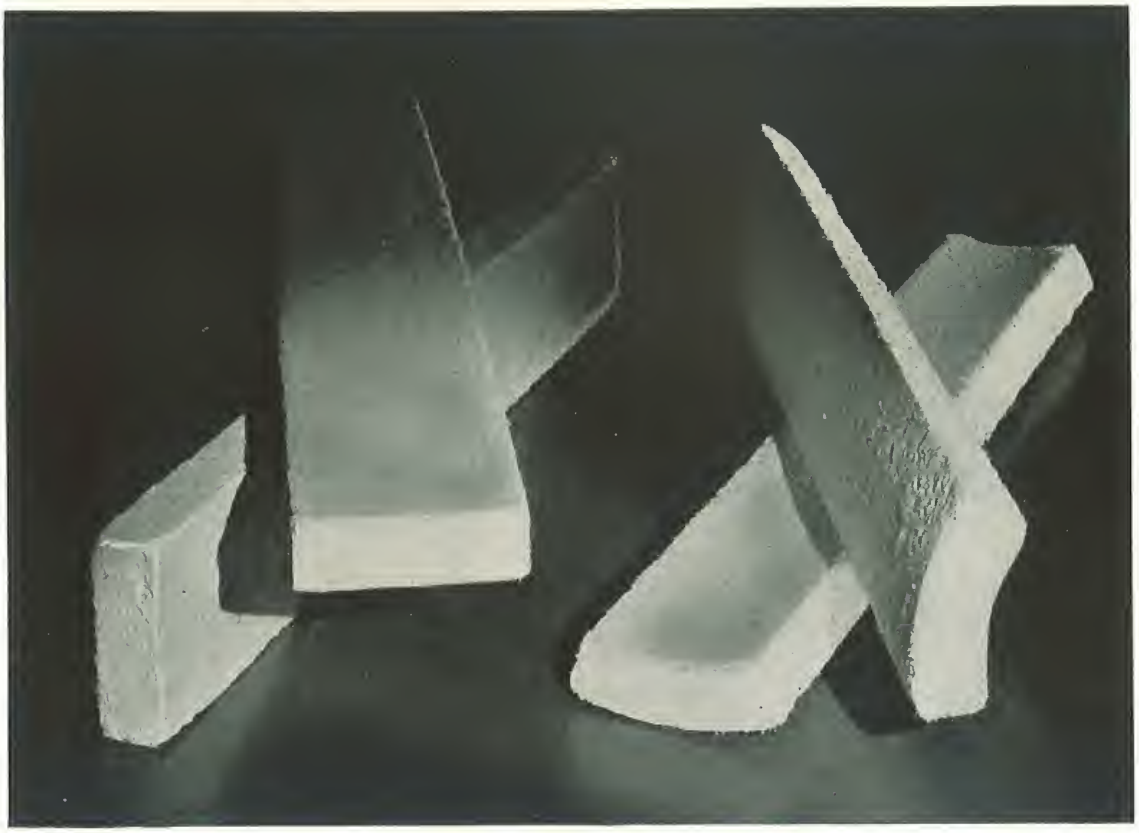
EHRET
INSULATIONS

Ehret's Enduro — 85% Magnesia Combination Pipe Insulation

EFFICIENCIES and HEAT LOSSES

BTU Losses per Square Foot of Pipe Surface per Hour per Degree temperature difference between pipe and air

Pipe Temperature			570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.	
Temperature Difference			500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.	
Pipe Size	Thickness Enduro	Thickness 85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
14"	Bare	.....	4.590	.....	5.460	.....	6.390	.....	7.360	.....	8.370	.....	9.340	.....
	1½"	Standard	.195	95.74	.204	96.26	.214	96.65	.223	96.97				
	1½"	1½"	.195	95.74	.204	96.26	.214	96.65	.223	96.97				
	1½"	2"	.167	96.36	.175	96.79	.183	97.13	.191	97.41				
	1½"	2½"	.153	96.67	.160	97.07	.166	97.40						
	1½"	3"	.139	96.97	.146	97.33	.152	97.62						
	2"	Standard	.170	96.28	.180	96.71	.189	97.03	.197	97.34	.206	97.55		
	2"	1½"	.170	96.28	.180	96.71	.189	97.03	.197	97.34	.206	97.55		
	2"	2"	.156	96.61	.163	97.01	.169	97.35	.176	97.61				
	2"	2½"	.143	96.89	.149	97.27	.155	97.57	.161	97.84				
	2"	3"	.132	97.13	.137	97.49	.142	97.78						
	2½"	Standard	.158	96.56	.166	96.96	.173	97.31	.180	97.58	.186	97.78		
	2½"	1½"	.158	96.56	.166	96.96	.173	97.31	.180	97.58	.186	97.78		
	2½"	2"	.145	96.85	.152	97.21	.158	97.54	.163	97.81	.170	97.97		
	2½"	2½"	.134	97.09	.139	97.45	.144	97.75	.150	97.97				
	2½"	3"	.125	97.28	.130	97.62	.135	97.89	.140	98.10				
	3"	2"	.136	97.04	.141	97.42	.146	97.71	.152	97.94	.159	98.10		
	3"	2½"	.127	97.24	.132	97.58	.137	97.86	.142	98.08	.147	98.24		
	3"	3"	.121	97.37	.125	97.71	.129	97.98	.136	98.15				
16"	Bare	.....	4.570	.....	5.440	.....	6.370	.....	7.340	.....	8.350	.....	9.320	.....
	1½"	Standard	.193	95.80	.201	96.30	.210	96.70	.218	97.03				
	1½"	1½"	.193	95.80	.201	96.30	.210	96.70	.218	97.03				
	1½"	2"	.164	96.41	.171	96.84	.178	97.21	.184	97.49				
	1½"	2½"	.149	96.73	.157	97.10	.163	97.45						
	1½"	3"	.135	97.00	.142	97.40	.148	97.67						
	2"	Standard	.168	96.30	.174	96.80	.182	97.14	.188	97.43	.196	97.66		
	2"	1½"	.168	96.30	.174	96.80	.182	97.14	.188	97.43	.196	97.66		
	2"	2"	.151	96.69	.159	97.04	.165	97.41	.170	97.68				
	2"	2½"	.135	96.98	.144	97.34	.150	97.64	.156	97.87				
	2"	3"	.125	97.26	.130	97.60	.135	97.88						
	2½"	Standard	.153	96.64	.162	97.00	.168	97.36	.173	97.64	.180	97.84	.186	98.00
	2½"	1½"	.153	96.64	.162	97.00	.168	97.36	.173	97.64	.180	97.84	.186	98.00
	2½"	2"	.141	96.91	.146	97.30	152	97.62	.158	97.85	.165	98.02		
	2½"	2½"	.127	97.22	.132	97.57	.137	97.85	.146	98.01				
	2½"	3"	.120	97.37	.125	97.70	.130	97.96	.136	98.15				
	3"	2"	.129	97.18	.134	97.53	.139	97.82	.148	97.98	.153	98.17		
	3"	2½"	.122	97.33	.127	97.66	.132	97.93	.138	98.12	.143	98.29		
	3"	3"	.116	97.46	.121	97.77	.126	98.02	.132	98.20				
18"	Bare	.....	4.550	.....	5.420	.....	6.350	.....	7.320	.....	8.330	.....	9.300	.....
	1½"	Standard	.190	95.82	.198	96.34	.206	96.76	.216	97.05				
	1½"	1½"	.190	95.82	.198	96.34	.206	96.76	.216	97.05				
	1½"	2"	.162	96.44	.169	96.88	.176	97.23	.182	97.52				
	1½"	2½"	.145	96.81	.152	97.18	.159	97.49						
	1½"	3"	.130	97.14	.137	97.47	.144	97.73						
	2"	Standard	.166	96.35	.173	96.82	.180	97.16	.186	97.46	.192	97.69		
	2"	1½"	.166	96.35	.173	96.82	.180	97.16	.186	97.46	.192	97.69		
	2"	2"	.148	96.75	.155	97.14	.161	97.46	.167	97.72				
	2"	2½"	.133	97.08	.140	97.43	.146	97.70	.153	97.91				
	2"	3"	.121	97.34	.127	97.67	.133	97.91						
	2½"	Standard	.150	96.70	.158	97.10	.164	97.42	.169	97.69	.175	97.89	.180	98.07
	2½"	1½"	.150	96.70	.158	97.10	.164	97.42	.169	97.69	.175	97.89	.180	98.07
	2½"	2"	.135	97.03	.142	97.39	.148	97.67	.155	97.88	.162	98.05		
	2½"	2½"	.123	97.30	.129	97.63	.135	97.87	.142	98.06				
	2½"	3"	.116	97.45	.121	97.78	.126	98.02	.132	98.19				
	3"	2"	.125	97.25	.131	97.59	.137	97.84	.144	98.03	.150	98.19		
	3"	2½"	.118	97.41	.123	97.74	.128	97.98	.134	98.16	.138	98.34		
	3"	3"	.112	97.54	.116	97.86	.120	98.11	.127	98.26				
20"	Bare	.....	4.530	.....	5.400	.....	6.330	.....	7.300	.....	8.310	.....	9.280	.....
	1½"	Standard	.187	95.86	.194	96.42	.202	96.80	.210	97.12				
	1½"	1½"	.187	95.86	.194	96.42	.202	96.80	.210	97.12				
	1½"	2"	.160	96.46	.166	96.93	.172	97.28	.179	97.54				
	1½"	2½"	.143	96.84	.148	97.26	.153	97.58						
	1½"	3"	.128	97.17	.133	97.54	.138	97.81						
	2"	Standard	.162	96.42	.168	96.89	.174	97.25	.181	97.52	.187	97.75		
	2"	1½"	.162	96.42	.168	96.89	.174	97.25	.181	97.52	.187	97.75		
	2"	2"	.145	96.79	.150	97.22	.156	97.53	.162	97.78				
	2"	2½"	.130	97.12	.135	97.50	.140	97.78	.147	97.98				
	2"	3"	.118	97.39	.123	97.73	.130	97.94						
	2½"	Standard	.147	96.75	.153	97.17	.159	97.48	.164	97.75	.170	97.96	.176	98.10
	2½"	1½"	.147	96.75	.153	97.17	.159	97.48	.164	97.75	.170	97.96	.176	98.10
	2½"	2"	.132	97.08	.138	97.45	.143	97.74	.149	97.95	.155	98.14		
	2½"	2½"	.120	97.34	.125	97.69	.132	97.91	.138	98.10				
	2½"	3"	.112	97.52	.117	97.84	.122	98.07	.128	98.24				
	3"	2"	.122	97.30	.128	97.63	.134	97.88	.140	98.08	.146	98.24		
	3"	2½"	.114	97.48	.120	97.78	.124	98.04	.130	98.21	.135	98.38		
	3"	3"	.108	97.61	.113	97.91	.118	98.13	.123	98.31				



EHRET'S ENDURO BLOCKS . . .

For the insulation of equipment in the high temperature field, ranging from 600° F. to 2000° F., Ehret's Enduro Block is highly satisfactory. Where conditions require only a single layer of this material, it is used as such. But in multiple-layer insulation Ehret's 85% Magnesia Block is usually applied over the Enduro Block, because of the additional heat savings that result therefrom.

Where great structural strength is not required, block-type insulation offers several advantages over brick-type insulation. Due to the relatively large sizes in which blocks are available, the number of crevices and joints are held to a minimum which practically eliminates air infiltration. Because of the easy workability of Enduro-85% Magnesia Block insulation, both joints and edges of insulated areas may be fitted close and tight. Staggering of joints in multiple-layer insulations also decreases the chance of heat loss from air leaks. Infiltration through insulated areas on equipment such as furnaces, kilns, retorts, etc., not only causes heat losses but may greatly interfere with the operating characteristics of the equipment, with subsequent damage to the material being processed.

Another advantage of block-type insulation is that it is easier to remove and re-apply than brick-type materials, and it has 100% re-use value.

Flat Blocks

Enduro is furnished in flat blocks, standard widths being 3″, 6″ and 12″ and standard lengths of 18″ and 36″. Enduro weighs approximately twenty-five pounds per cubic foot.

Thicknesses of Ehret's Enduro Block are from 1″ up to 3″ in ⅛″ increments, and 3¼″, 3½″ and 4″. Blocks of 12″ width are not regularly furnished less than 1½″ in thickness.

Curved Blocks

Ehret's Enduro can be furnished in curved blocks in the same sizes as flat blocks, with a minimum thickness of 1¼″. The maximum thickness is that which can be cut from a 4″ thick flat block. The radius of curvature which the block must fit should be specified on all orders placed for curved blocks.

Special Sizes and Shapes

Enduro can be supplied, when requested, in special sizes and shapes. Blocks or lagging, either flat or curved, can be made in shapes such as tapered forms, wedges, etc., to fit unusual shaped equipment. Dimensions desired or drawings of the equipment to be covered are required for designing special shapes of Enduro Blocks.

Printed in U. S. A. 11-38

EHRET
INSULATIONS

Combination Enduro-85% Magnesia Blocks

It is common practice to use Enduro Blocks in combination with Ehret's 85% Magnesia Blocks on high temperature applications. In applying this combination insulation, the Enduro should be applied next to the heated surface and its thickness should be sufficient to hold the temperature of the inner face of the 85% Magnesia to less than 600° F.

Enduro Cement

Consisting of the same material as the standard molded forms, Ehret's Enduro Cement is light and fluffy in character and needs only to be mixed with water to make a plastic cement that, when properly applied and trowelled down, will become firm when dry. It can be used as a monolithic insulation, but such use should be limited to where the application of blocks is not practical.

Enduro Cement is used, in conjunction with blocks, for pointing and is also used for covering flanges, fittings and equipment in which temperatures are higher than 600° F. When properly mixed with water, 100 lbs. of the dry Enduro will cover about 53 sq. ft., 1" thick. Packed in 75-lb. bags and 90-lb. barrels.

Packaging

Enduro blocks are packed in cartons and also in wooden cases that contain approximately 4 times the carton contents. The following table gives the packaging contents for the most commonly used thicknesses of flat Enduro Blocks.

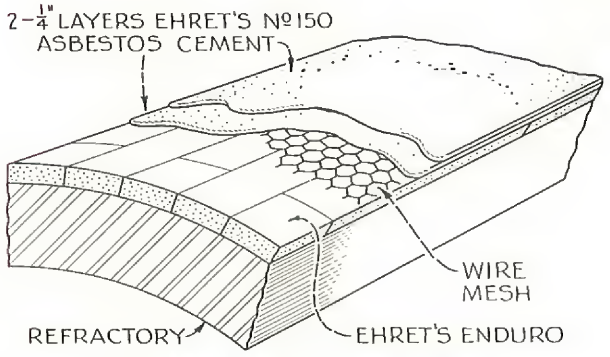
PACKAGING DATA

Ehret's Enduro Blocks—6" x 36", Flat

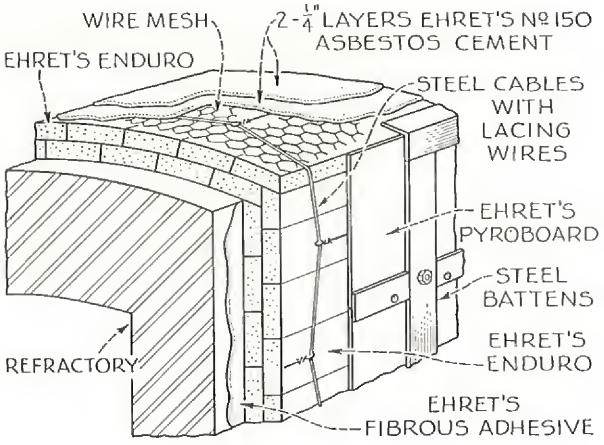
Thickness	Cartons		Cases	
	No. of Pieces	Total Sq. Ft.	No. of Pieces	Total Sq. Ft.
1"	24	36	96	144
1¼"	20	30	76	114
1½"	16	24	64	96
2"	12	18	48	72
2½"	10	15	38	57
3"	8	12	32	48
4"	6	9	24	36

Note: For blocks 12" x 36", divide the number of pieces as given in table by 2.

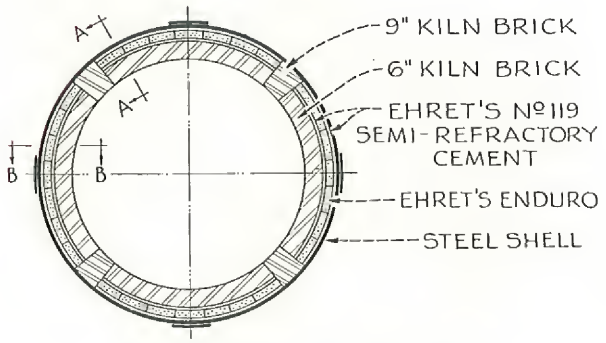
TYPICAL ENDURO BLOCK APPLICATION DETAILS



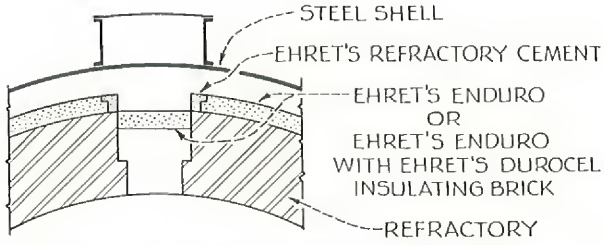
NEW REGENERATOR ROOF DETAIL



POT ARCH DETAIL



ROTARY KILN-SECTION



HOT BLAST STOVE – DOME DETAIL

EHRET'S ENDURO BLOCK INSULATION

Efficiencies and BTU Losses per Square Foot of hot surface per Hour per Degree temperature difference between hot surface and air

Temperature Hot Surface	570° F.		670° F.		770° F.		870° F.		970° F.		1170° F.		1170° F.		1270° F.	
Temperature Difference	500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.		1100° F.		1200° F.	
Thickness	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
Bare	4.320	....	5.150	....	6.040	....	6.950	....	7.910	....	8.850	....	9.750	....	10.700	....
1 Inch	.432	90.00	.452	91.22	.473	92.17	.493	92.91	.514	93.50	.534	93.96	.555	94.31	.576	94.61
1½ "	.315	92.71	.326	93.67	.337	94.42	.348	95.00	.360	95.45	.371	95.81	.383	96.07	.394	96.32
2 "	.246	94.30	.254	95.06	.263	95.64	.271	96.10	.280	96.46	.288	96.74	.297	96.95	.306	97.14
2½ "	.202	95.32	.209	95.93	.216	96.43	.223	96.78	.230	97.10	.238	97.31	.245	97.49	.252	97.65
3 "	.170	96.06	.176	96.56	.182	96.98	.188	97.29	.194	97.57	.200	97.73	.206	97.89	.212	98.01
3½ "	.150	96.51	.155	96.98	.160	97.35	.165	97.62	.170	97.87	.175	98.02	.180	98.15	.186	98.25
4 "	.137	96.82	.141	97.24	.145	97.59	.150	97.84	.154	98.07	.158	98.22	.162	98.34	.166	98.44
4½ "	.121	97.18	.125	97.58	.129	97.86	.134	98.07	.138	98.26	.142	98.39	.146	98.50	.150	98.60
5 "	.112	97.40	.115	97.77	.119	98.02	.122	98.24	.126	98.42	.130	98.52	.134	98.63	.138	98.71

EHRET'S ENDURO-85% MAGNESIA COMBINATION-BLOCK ONLY

Efficiencies and BTU Losses per Square Foot of hot surface per Hour per Degree temperature difference between hot surface and air

Temperature Hot Surface		570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.		1170° F.	
Temperature Difference		500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.		1100° F.	
Block Thickness		BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
Enduro	85% Mag.														
Bare		4.320	....	5.150	....	6.040	....	6.950	....	7.910	....	8.850	....	9.750	....
1"	1"	.238	94.49	.246	95.20	.254	95.81	.262	96.23						
1"	1½"	.192	95.56	.199	96.13	.206	96.60								
1"	2"	.161	96.28	.166	96.76	.172	97.15								
1½"	1"	.196	95.46	.203	96.05	.210	96.52	.217	96.87	.224	97.18				
1½"	1½"	.163	96.24	.169	96.70	.174	97.12	.180	97.41	.185	97.69				
1½"	2"	.144	96.66	.148	97.10	.153	97.48	.157	97.74						
1½"	2½"	.130	96.98	.134	97.38	.138	97.71								
1½"	3"	.114	97.36	.118	97.72	.122	97.98								
2"	1"	.166	96.15	.172	96.64	.177	97.08	.183	97.36	.188	97.65	.194	97.80	.200	97.95
2"	1½"	.146	96.61	.151	97.05	.156	97.42	.161	97.68	.166	97.92				
2"	2"	.131	96.95	.135	97.36	.139	97.70	.144	97.92						
2"	2½"	.115	97.33	.119	97.70	.123	97.96	.127	98.16						
2"	3"	.106	97.54	.110	97.87	.113	98.14	.117	98.31						
2½"	1"	.147	96.58	.152	97.03	.157	97.40	.162	97.67	.167	97.91	.172	98.05	.177	98.19
2½"	1½"	.132	96.93	.136	97.34	.140	97.68	.145	97.91	.149	98.13	.153	98.27		
2½"	2"	.116	97.29	.120	97.68	.124	97.95	.128	98.15	.132	98.35				
2½"	2½"	.107	97.52	.111	97.85	.114	98.12	.118	98.30						
2½"	3"	.099	97.70	.102	98.02	.105	98.26	.108	98.44						
3"	2"	.108	97.49	.112	97.83	.115	98.10	.119	98.28	.123	98.46	.126	98.57		
3"	2½"	.100	97.67	.103	98.00	.106	98.25	.109	98.43	.112	98.59				
3"	3"	.090	97.88	.093	98.19	.096	98.40	.100	98.56						

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EHRET
INSULATIONS

EHRET'S ENDURO — 85% MAGNESIA COMBINATION BLOCKS with 1/2" of Asbestos Cement and Canvas Finish

Efficiencies and BTU Losses per Square Foot of hot surface per Hour per Degree temperature difference between hot surface and air

Temperature Hot Surface		570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.		1170° F.	
Temperature Difference		500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.		1100° F.	
Block Thickness Enduro	85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
Bare		4.320	....	5.150	....	6.040	....	6.950	....	7.910	....	8.850	....	9.750	....
1"	1"	.210	95.23	.217	95.77	.224	96.29	.231	96.67						
1"	1½"	.169	96.09	.175	96.58	.182	96.98								
1"	2"	.148	96.55	.153	97.01	.158	97.38								
1½"	1"	.171	96.04	.177	96.54	.183	96.97	.189	97.28	.195	97.56				
1½"	1½"	.149	96.53	.154	97.00	.159	97.37	.164	97.64	.169	97.88				
1½"	2"	.135	96.86	.139	97.28	.143	97.63	.147	97.87						
1½"	2½"	.118	97.24	.122	97.64	.126	97.92								
1½"	3"	.109	97.47	.112	97.83	.115	98.10								
2"	1"	.151	96.49	.156	96.96	.161	97.34	.166	97.61	.171	97.86	.177	97.99		
2"	1½"	.136	96.84	.140	97.26	.144	97.61	.148	97.86	.153	98.08				
2"	2"	.119	97.22	.123	97.62	.127	97.90	.131	98.11						
2"	2½"	.110	97.45	.114	97.79	.117	98.06	.120	98.27						
2"	3"	.101	97.65	.104	97.98	.107	98.23	.111	98.40						
2½"	1"	.138	96.80	.142	97.22	.146	97.58	.150	97.84	.155	98.05	.159	98.21	.163	98.33
2½"	1½"	.120	97.20	.124	97.60	.128	97.88	.132	98.10	.136	98.29	.140	98.41		
2½"	2"	.111	97.42	.115	97.77	.118	98.04	.121	98.25	.124	98.44				
2½"	2½"	.103	97.61	.106	97.94	.110	98.18	.113	98.37						
2½"	3"	.092	97.83	.095	98.15	.098	98.37	.101	98.55						
3"	2"	.104	97.58	.107	97.92	.111	98.17	.114	98.36	.117	98.52	.120	98.64		
3"	2½"	.094	97.79	.097	98.12	.100	98.34	.104	98.50	.107	98.65				
3"	3"	.087	97.95	.090	98.25	.092	98.47	.095	98.64						

EHRET'S ENDURO — 85% MAGNESIA COMBINATION BLOCKS with 1/4" of Asbestos Cement and 1/4" of Hard Finish Cement

Efficiencies and BTU Losses per Square Foot of hot surface per Hour per Degree temperature difference between hot surface and air

Temperature Hot Surface		570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.		1170° F.	
Temperature Difference		500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.		1100° F.	
Block Thickness Enduro	85% Mag.	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
Bare		4.320	....	5.150	....	6.040	....	6.950	....	7.910	....	8.850	....	9.750	....
1"	1"	.236	94.54	.243	95.26	.250	95.86	.258	96.28						
1"	1½"	.184	95.74	.190	96.31	.197	96.75								
1"	2"	.158	96.34	.164	96.80	.169	97.20								
1½"	1"	.188	95.65	.194	96.23	.200	96.69	.207	97.01	.214	97.31				
1½"	1½"	.160	96.30	.166	96.76	.171	97.17	.177	97.45	.182	97.73				
1½"	2"	.143	96.69	.147	97.12	.152	97.49	.156	97.75						
1½"	2½"	.126	97.08	.130	97.47	.134	97.77								
1½"	3"	.113	97.38	.117	97.73	.121	97.99								
2"	1"	.164	96.20	.170	96.68	.175	97.11	.181	97.39	.186	97.68	.191	97.83	.198	97.97
2"	1½"	.145	96.63	.150	97.07	.154	97.46	.159	97.71	.164	97.95				
2"	2"	.127	97.06	.131	97.45	.135	97.76	.140	97.98						
2"	2½"	.114	97.36	.118	97.72	.122	97.98	.126	98.18						
2"	3"	.105	97.56	.108	97.90	.111	98.17	.115	98.34						
2½"	1"	.146	96.61	.151	97.05	.156	97.42	.161	97.68	.166	97.92	.171	98.06	.175	98.21
2½"	1½"	.128	97.04	.132	97.43	.136	97.74	.141	97.97	.145	98.18	.149	98.32		
2½"	2"	.115	97.33	.119	97.70	.123	97.96	.127	98.16	.130	98.37				
2½"	2½"	.106	97.54	.109	97.88	.113	98.14	.116	98.33						
2½"	3"	.096	97.74	.100	98.06	.103	98.29	.106	98.47						
3"	2"	.107	97.52	.110	97.87	.114	98.12	.117	98.31	.120	98.49	.124	98.60		
3"	2½"	.097	97.72	.101	98.04	.104	98.28	.107	98.45	.110	98.61				
3"	3"	.091	97.85	.093	98.19	.095	98.41	.098	98.59						

Fire Brick Walls Faced With Enduro Block

Thickness Inches		TEMPERATURE IN DEGREES FAHRENHEIT OF INNER SURFACE OF ENDURO BLOCK — Room Temperature 70° F. — Inside Furnace Temperature, in °F.											TEMPERATURE IN DEGREES FAHRENHEIT OF OUTER SURFACE OF ENDURO BLOCK — Room Temperature 70° F. — Inside Furnace Temperature, in °F.										
Fire brick	Enduro	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
	0												395	440	495	535	580	620	660				
	1½	875	1060	1225	1400	1575	1750	1925					192	220	250	275	295	320	345				
	2	900	1080	1260	1440	1620	1800	1980					174	199	222	247	270	295	315				
	3	920	1104	1288	1472	1656	1840						150	171	190	208	224	245	255				
	4	935	1121	1307	1493	1679	1865						136	152	167	182	195	209					
4½																							
	5	950	1137	1324	1511	1698	1885						126	140	154	166	177	189					
	6	960	1148	1336	1524	1712	1900						120	133	144	154	165	174					
	7	970	1159	1348	1537	1726	1915						115	125	135	144	153	161					
	8	980	1170	1360	1550	1740	1930						110	120	128	137	143	151					
	9	990	1181	1372	1563	1754	1945						106	115	122	129	137	142					
	0												300	340	375	410	440	465	495	525	555	575	595
	1½	790	950	1105	1270	1420	1580	1740	1900				175	201	224	250	275	300	320	335			
	2	830	995	1160	1325	1490	1635	1820	1985				162	185	206	226	250	270	285	297			
	3	870	1041	1211	1382	1553	1724	1895					145	163	179	195	210	224	247				
	4	900	1074	1248	1422	1596	1770	1942					131	144	157	173	184	196	214				
9																							
	5	925	1101	1277	1454	1630	1806	1982					122	136	148	160	172	183	193				
	6	945	1124	1303	1482	1661	1840						115	127	139	149	158	168					
	7	965	1146	1327	1508	1689	1870						110	120	130	140	148	156					
	8	970	1153	1336	1519	1702	1885						106	115	124	133	140	147					
	9	980	1165	1350	1535	1725	1910						103	112	119	126	133	139					
	0												255	285	325	355	380	405	425	445	465	485	505
	1½	715	864	1010	1172	1290	1430	1570	1708	1822	2000		165	187	207	226	248	269	285	296	315	340	
	2	770	920	1070	1220	1370	1520	1670	1820	1970			153	173	191	209	224	245	255	277	300		
	3	810	971	1132	1293	1454	1615	1776	1937				138	153	169	184	199	213	227	245			
	4	845	1011	1177	1343	1509	1675	1841					127	142	156	169	181	192	204				
13½																							
	5	875	1045	1215	1385	1555	1725	1895					120	133	144	155	166	176	187				
	6	900	1074	1248	1422	1596	1770	1944					114	125	136	144	154	162	172				
	7	920	1097	1274	1451	1628	1805	1982					108	119	128	138	145	154	161				
	8	935	1114	1293	1472	1651	1830	2009					104	114	123	131	139	145	154				
	9	950	1132	1314	1496	1678	1860						102	108	117	124	131	138					
	0												225	247	270	300	330	360	375	400	420	435	460
	1½	660	790	922	1043	1175	1300	1420	1527	1670	1840	1950	154	173	192	209	226	247	270	281	295	322	333
	2	720	856	992	1126	1262	1398	1534	1670	1806	1942		145	164	181	197	212	226	245	255	270	285	295
	3	770	918	1066	1214	1362	1510	1658	1806	1954			133	148	164	177	191	204	215	226	237		
	4	810	969	1128	1287	1446	1605	1764	1923				124	138	151	164	175	187	197	207			
18																							
	5	835	1000	1165	1330	1495	1660	1825	1990				119	131	142	154	165	174	183	191			
	6	850	1021	1192	1363	1534	1705	1876					113	124	135	144	151	161	171				
	7	875	1048	1221	1394	1567	1740	1913					107	118	127	136	144	153	160				
	8	890	1065	1240	1415	1590	1765	1940					103	113	122	129	138	145	153				
	9	905	1081	1257	1433	1609	1785	1961					99	107	115	124	131	138	144				
	0												185	215	244	270	295	325	350	370	385	405	420
	1½	620	730	850	960	1080	1200	1330	1440	1550	1680	1800	146	165	182	198	214	228	245	255	270	283	295
	2	680	806	932	1048	1174	1300	1426	1552	1678	1804	1940	138	155	170	189	204	217	227	238	252	260	271
	3	740	882	1024	1166	1308	1450	1592	1734	1876			128	144	157	170	183	195	207	218	228		
	4	780	932	1084	1236	1388	1540	1692	1844	1996			121	135	146	157	169	179	196	201	210		
22½																							
	5	810	969	1128	1287	1446	1605	1764	1923				114	126	138	147	157	167	175	184			
	6	825	990	1155	1320	1485	1650	1815	1980				108	120	129	139	148	156	165	172			
	7	835	1006	1177	1348	1519	1690	1861					105	115	125	135	138	146	155				
	8	845	1019	1193	1367	1541	1715	1889					102	111	119	127	135	142	148				
	9	855	1033	1211	1389	1567	1745	1923					98	106	114	122	129	137	143				

EHRET INSULATIONS

Fire Brick Walls Faced with Enduro Block

Overall Heat Losses in BTUs per square foot, per hour

Room Temperature 70° F.

Thickness Inches		Inside Furnace Temperature, in °F.										
Fire brick	Enduro	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
	0	1050	1350	1700	2050	2450	2850	3250	3700	4150	4550	5000
	1½	265	350	435	520	605	690	775				
	2	215	285	355	425	495	565	635				
	3	155	207	259	311	363	415	470				
	4	120	159	198	237	276	315					
4½												
	5	100	131	163	194	225	257					
	6	87	113	139	165	191	217					
	7	76	97	118	139	160	182					
	8	68	86	104	121	138	156					
	9	61	76	91	106	121	136					
	0	625	800	950	1150	1350	1500	1700	1900	2150	2400	2650
	1½	220	291	362	433	504	575	646	717			
	2	185	246	307	368	429	490	550	610			
	3	143	187	231	275	315	363	410				
	4	110	141	173	214	245	277	330				
9												
	5	90	120	150	180	210	240	270				
	6	78	103	127	152	176	201					
	7	67	87	108	129	150	170					
	8	60	78	95	113	130	148					
	9	55	70	85	100	114	128					
	0	475	550	700	825	960	1125	1250	1360	1500	1650	1800
	1½	190	250	310	370	430	490	550	610	670	730	
	2	160	212	263	315	362	417	475	527	579		
	3	125	161	203	244	286	327	373	414			
	4	103	136	169	202	235	266	300				
13½												
	5	87	114	141	168	195	221	250				
	6	75	97	119	141	163	185	210				
	7	65	85	104	124	144	163	182				
	8	57	75	92	110	127	144	163				
	9	52	65	80	95	110	125					
	0	350	425	510	625	750	850	950	1060	1200	1325	1450
	1½	165	212	265	317	370	422	480	538	596	654	712
	2	143	189	235	280	326	371	418	465	512	559	
	3	114	151	188	225	262	299	335	371	407		
	4	95	126	157	188	219	250	280	310			
18												
	5	85	111	137	163	190	216	240	264			
	6	73	95	117	139	161	183	208				
	7	62	82	101	120	140	160	180				
	8	55	72	90	107	125	142	160				
	9	47	63	78	94	110	126	141				
	0	250	325	400	500	600	700	800	900	1000	1100	1200
	1½	145	191	237	283	330	376	420	464	508	552	596
	2	125	166	207	258	300	340	375	410	445	480	515
	3	105	139	173	206	240	274	308	342	376		
	4	88	117	145	174	202	231	260	290	320		
22½												
	5	75	100	124	148	172	196	220	244			
	6	65	86	107	128	150	171	190	210			
	7	58	78	97	117	126	146	168				
	8	52	69	85	101	118	134	150				
	9	45	60	75	91	107	122	138				

SPECIFICATIONS

FOR EHRET'S ENDURO–85% MAGNESIA COMBINATION INSULATION

Pipe-Coverings, Blocks and Plastic Cement

GENERAL

All piping and equipment included in this specification shall be insulated in a neat and workmanlike manner in accordance with the following:

MATERIALS

The insulating material supplied and installed under this specification shall be Ehret's 85% Magnesia and/or Ehret's Enduro in molded and plastic cement form. Molded forms, consisting of pipe coverings and blocks, shall be used wherever practicable.

THICKNESSES

The thicknesses applied shall be equal to or greater than those listed in the table below.

APPLICATIONS

Pipe Coverings, Pasted-and-Banded

All sectional coverings shall be carefully fitted to the pipes with side and end joints butted tightly. The side and end laps of factory-weight canvas shall then be pasted down smoothly.

In applying double layer coverings, the inner layer shall be securely wired in place with No. 18 gauge annealed iron wire. The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the covering. The outer layer shall then be applied with the side and end joints staggered.

After the factory-weight canvas jacket on the outer layer has been smoothly pasted down, factory metal bands shall be applied, two bands for each section of covering. One band shall be placed at the midpoint of each section and one band centered over the joint at the end.

All segmental coverings shall be carefully fitted and applied in a manner similar to that specified for sectional coverings, except that since no factory-weight canvas is attached to the outer surface, all layers shall be wired on in the manner described above for inner layers of double layer coverings. All joints shall be tightly butted together and after being wired in place the joints between segments shall be carefully tapped and rubbed closed with a smooth tool.

Factory-weight canvas jackets shall then be stretched over the surface of the covering and pasted down smoothly with 3-inch laps at all edges. Bands shall then be applied in the manner described above.

Sewed Jackets

Where sewed jackets are desired, the coverings shall be applied in the above described manner except the application of metal bands over the

MINIMUM THICKNESS FOR *INDOOR CONDITIONS

PIPE SIZES	TEMPERATURE OF HOT SURFACE, IN °F.									
	Under 300°	301° to 400°	401° to 500°	501° to 600	601° to 700°		701° to 800°		801° to 900°	
	Mag.	Mag.	Mag.	Mag.	End.	Mag.	End.	Mag.	End.	Mag.
Up to 1½" incl.	Stand.	1½"	2"	2"	2"	.....	2"	.....	2"	.....
2" to 4" incl.	Stand.	1½"	2"	2"	1½"	1½"	1½"	2"	2"	2"
4½" to 6" incl.	Stand.	2"	Dbl. Std.	Dbl. Std.	1½"	2"	1½"	2"	2"	2"
7" and up	Stand.	2"	Dbl. Std.	Dbl. Std.	1½"	2"	2"	2"	2"	2½"
Flat Blocks	1½"	2"	2½"	3"	1½"	2"	2"	2"	2"	2½"

Mag.—85% Magnesia. End.—Enduro Stand.—Standard Thick. Dbl. Std.—Double Standard Thick.

*Where the insulation is to be applied on weather-exposed or extremely long lines, or where it is highly desirable to maintain temperatures or to minimize steam condensation, thicknesses should be at least ½" greater than those recommended in the above table.

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pasted jacket shall be omitted. A layer of 40-pound rosin-sized paper shall be carefully wrapped around the covering and over this paper there shall be tightly and smoothly stretched a jacket of 8-ounce enamelling duck, which shall be securely and neatly sewed in place. Seams shall be located where least visible.

The general appearance of sewed jacket applications is improved if metal bands are placed on either side of fittings and at terminals such as walls, partitions or bulkheads.

Pipe Coverings to Be Concealed in Walls, Partitions or Floors

Concealed pipe coverings shall be applied in the same manner as described under "Pasted-and-Banded Coverings" except the metal bands shall be omitted, and instead each section of covering shall be securely fastened with 3 or more loops of No. 16 gauge soft copper wire.

Valves and Fittings

All valves and fittings shall be insulated with the same type materials and to the same total thickness as the covering on the adjacent piping.

On pipe fittings 4-inch and larger, Ehret's Insulation Blocks shall be applied allowing for a ½-inch coating of cement. These blocks shall be securely wired in place with No. 16 gauge annealed iron wire.

For pipe sizes under 4 inches, an all-cement insulation may be used instead of the block and cement finish. The cement shall be Ehret's Enduro Cement or Ehret's No. 18 Heat-Seal Cement applied in two or more layers according to the total thickness. Each layer of cement shall be permitted to dry before the next is applied. The outer surface shall be trowelled smooth. All valve bonnets shall be insulated up to the stuffing boxes.

The outer surface of insulation on valves and fittings shall be finished with pasted-on factory-weight canvas jackets, or

(Alternate) Where the adjacent coverings have a sewed jacket, the factory-weight canvas need not be applied. The sewed jacket shall be extended to include valves and fittings, or

(Alternate) Where a hard finish is desired, the outer layer of cement shall consist of Ehret's No. 150 Asbestos Cement trowelled to a firm and smooth surface.

Flanges

At flanges, the pipe coverings shall be terminated and beveled off at sufficient distances to permit removal of the flange bolts. Both removable and non-removable insulation coverings for flanges are described on a separate data sheet.

Weatherproofing

All insulation on outdoor piping shall be thoroughly weatherproofed. The sewed jacket should be omitted and in its stead a weatherproofing jacket of Ehret's 50-pound asphalt saturated-and-coated Roofing Felt shall be applied. The weatherproofing jacket shall be closely wrapped over the insulation with 3-inch laps at all edges and with all laps sealed with a waterproof, sealing compound. On horizontal pipes the longitudinal lap shall be placed at the side of the pipe with the lap turned downward to shed water. On vertical sections of the pipe the weatherproofing shall be lapped downward.

Separate loops of No. 16 gauge copperweld wire shall then be firmly fastened around the weatherproofing at spacings of not more than 6 inches. The ends of the wire loops shall be carefully twisted tight with pliers and turned over to avoid projections, care being taken not to puncture the weatherproofing.

Block Insulation

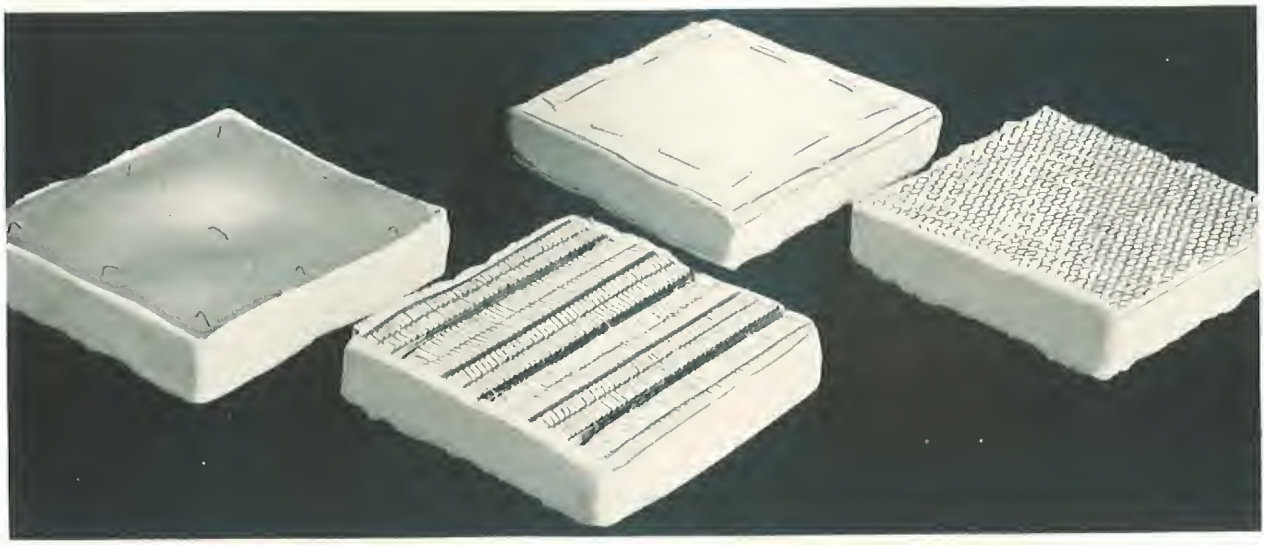
Blocks shall be secured by means of No. 16 gauge wire or ⅛-inch wire cables wrapped around or attached to available anchorages. After which, hexagonal mesh galvanized wire netting shall be tightly stretched over the entire surface and securely fastened down.

Where 2 or more layers of block are to be used, the blocks shall be applied with all joints staggered. A cement finish shall then be applied. This finish shall consist of Ehret's No. 150 Asbestos Cement, applied in two layers of at least ¼" thickness each.

(Alternate) when an extremely hard finish is desired, the outer layer shall contain from ⅓ to ½, by weight, of portland cement.

Weatherproofing Block Insulation

Where block insulation is to be protected from moisture, Ehret's Fibrekote shall be applied in successive layers to the desired thickness.



EHRET'S HEAT-SEAL INSULATING BLANKETS

Ehret's Heat-Seal Insulating Blankets have many and varied uses. They are particularly well suited for use where large sized units of flexible insulation are preferred and where the installations are apt to be temporary or require frequent removal for servicing the equipment.

Another field of use for Ehret's Heat-Seal Insulating Blankets is in the reduction of sound transmission from metal surfaces as well as through floors, walls and partitions of buildings.

Ehret's Heat-Seal Insulating Blankets are composed of a layer of long fibre, white mineral wool made by a special steam blowing process, firmly felted to the desired thickness and secured between sheets of metal mesh, lath or fabric by means of wire pins or stitches. It is important in a product of this kind that the loose-fibred material be felted to a uniform density. Ehret's Heat-Seal Insulating Blankets are carefully manufactured so that the insulating wool has a very uniform density of 11 to 12 pounds per cubic foot. The dimensions and thicknesses of Ehret's Heat-Seal Insulating Blankets are maintained to uniformly close tolerances, and all edges are trimmed smooth, full and square.

The type of Ehret's Heat-Seal Insulating Wool used in these blankets makes them absolutely fire-proof and vermin-proof, as well as highly resistant to moisture. However, the principal advantages of blanket-type insulation are flexibility and the fact that it is available in relatively large sized units.

Ehret's Heat-Seal Insulating Blankets are recommended for temperatures up to 1000 degrees F. The following table indicates the approximate recommended thicknesses for various operating temperatures:—

Hot Surface Temperature	Recommended thickness
Up to 100 degrees F.	1 inch
100 to 200 "	1½ "
200 to 300 "	2 "
300 to 400 "	2½ "
400 to 500 "	3 "
500 to 650 "	3½ "
650 to 800 "	4 "
800 to 900 "	5 "
900 to 1000 "	6 "

SIZES AND THICKNESSES

All styles of Ehret's Heat-Seal Insulating Blankets (except Style No. 87) are available in the two following standard sizes:

24″ x 48″ (8 sq. ft.)
24″ x 96″ (16 sq. ft.)

All Styles, with the exceptions noted, are available in the following thicknesses:

1″ 1¼″ 1½″ 1¾″ 2″ 2½″ 3″
3½″ 4″ 4½″ 5″ 5½″ and 6″

Special sizes and Blankets with cut-outs or holes, will be furnished on order.

Ehret's Heat-Sealed Insulating Blankets are regularly shipped in wooden crates.

Exceptions

Style No. 87 is made only in 24″ x 48″ size for thicknesses of 1″ to 3½″, inclusive, and in 24″ x 24″ size for the 4″ thickness.

Style No. 10 is also available in thicknesses of ½″, ⅝″, ¾″ and ⅞″.

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EHRET'S HEAT-SEAL INSULATING BLANKETS

AVAILABLE STYLES

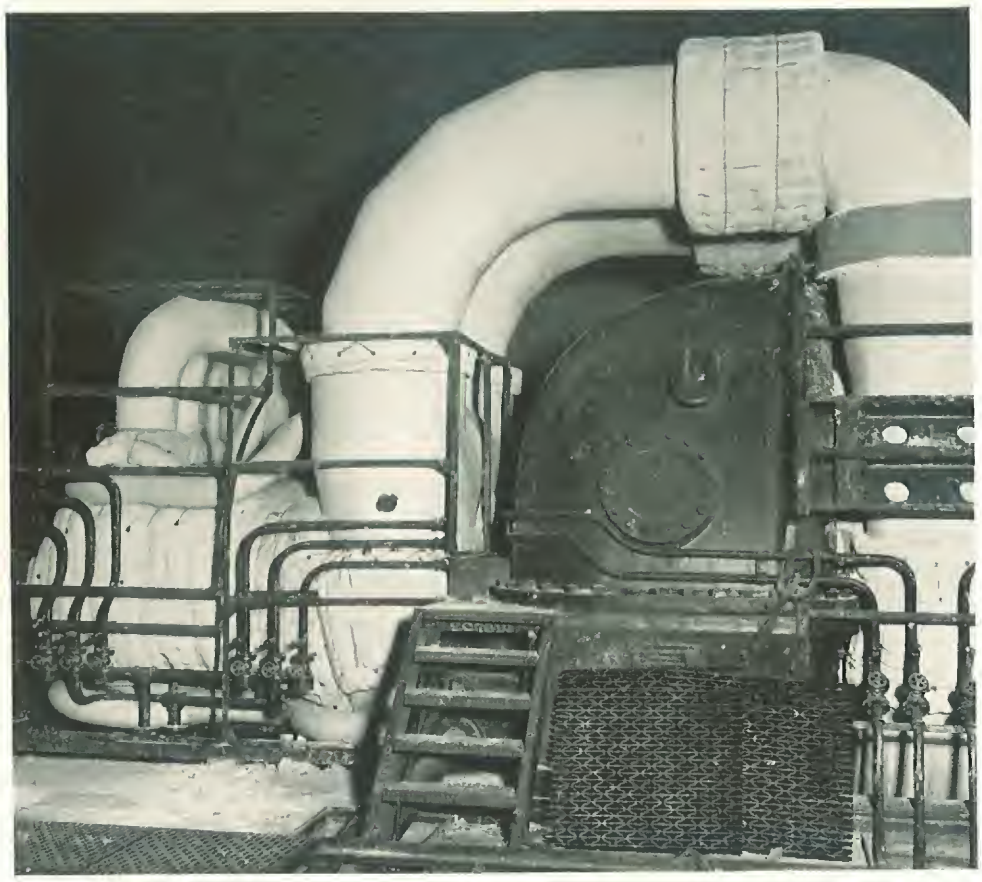
Style No.	Description	Uses and features
10	1″ hexagonal mesh wire—Both sides	Where a cement finish is not required—for stoves, ovens, etc.
20	1″ hexagonal mesh wire—One side Expanded metal lath—One side	Metal lath provides base for plastering—for oil refinery tanks, etc.
30	Expanded metal lath—Both sides	Where rigidity and structural strength is required—either side can be plastered.
40	1″ hexagonal mesh wire—One side ⅜″ rib expanded metal lath—One side	Generally furnished with rib turned in—where air space is desired, with rib turned out.
50	Expanded metal lath—One side ⅜″ rib lath—One side	Semi-rigid construction—ribs turned in or out.
60	1″ hexagonal mesh wire—One side ¾″ rib lath—One side	Greater rigidity due to high rib of the metal lath—ribs turned in or out.
70	Expanded metal lath—One side ¾″ rib lath—One side	Similar to style 50, only greater rigidity—ribs turned in or out.
80	⅜″ rib lath—Both sides	For forming partitions or panels—ribs turned in or out, lengthwise or at right angles.
87	Asbestos paper—Both sides	Where blankets come into direct contact with very hot surfaces.
90	12 mesh fly screen wire—Both sides	Very flexible, conforms to small-radius curves—for sound absorption and acoustics.

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in total BTUs per Square Foot per Hour

Temperature Hot Surface	170° F.		270° F.		370° F.		470° F.		570° F.		670° F.		770° F.		870° F.		970° F.		1070° F.		1170° F.	
Temperature Difference	100° F.		200° F.		300° F.		400° F.		500° F.		600° F.		700° F.		800° F.		900° F.		1000° F.		1100° F.	
Thickness	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
Bare	192	——	470	——	870	——	1424	——	2160	——	3090	——	4228	——	5560	——	7155	——	8850	——	10725	——
HEAT-SEAL BLANKETS—ONLY																						
1 Inch	19	90.10	39	91.70	67	92.30	96	93.26	129	94.03	167	94.60	205	95.15	254	95.43	310	95.67				
2 "	14	92.70	27	94.26	44	94.94	62	95.66	84	96.11	104	96.64	129	96.90	155	97.21	184	97.42	216	97.56	249	97.68
3 "	10	94.78	21	95.53	31	96.44	44	96.92	60	97.22	76	97.55	92	97.82	109	98.04	125	98.25	149	98.32	172	98.40
4 "			17	96.39	26	97.01	35	97.53	47	97.82	59	98.10	76	98.20	85	98.47	98	98.63	111	98.75	127	98.82
5 "			15	96.81	22	97.47	29	97.96	38	98.24	49	98.42	59	98.60	69	98.76	80	98.88	91	98.97	102	99.05
6 "					18	97.93	25	98.24	31	98.56	39	98.74	47	98.89	56	98.99	66	99.08	74	99.16	84	99.22
HEAT-SEAL BLANKETS WITH ½″ OF EHRET'S No. 150 ASBESTOS CEMENT																						
1 Inch	19	90.10	37	92.13	64	92.64	92	93.55	124	94.26	161	94.80	197	95.37	244	95.61	295	95.87				
2 "	14	92.70	26	94.47	42	95.17	60	95.80	81	96.25	100	96.77	125	97.00	150	97.30	178	97.51	209	97.64	242	97.74
3 "			20	95.75	30	96.55	43	96.97	58	97.31	73	97.64	90	97.87	106	98.09	122	98.29	145	98.36	168	98.44
4 "					25	97.13	34	97.61	46	97.87	58	98.13	74	98.25	83	98.51	96	98.66	108	98.78	123	98.86
5 "					21	97.59	28	98.03	37	98.29	47	98.48	57	98.65	67	98.80	78	98.91	89	99.00	100	99.07
6 "					17	98.05	24	98.31	30	98.61	38	98.77	46	98.91	54	99.03	64	99.11	73	99.17	82	99.23

Various parts of this Allis Chalmers steam turbine installation are protected with Ehret's Asbestos Insulating Blankets to facilitate the removal of insulation for inspection and servicing.



EHRET'S ASBESTOS INSULATING BLANKETS

Where piping or equipment calls for an insulation that requires frequent removal for inspection or servicing, the use of Ehret's Asbestos Insulating Blankets should be considered. Specifically designed for such purposes, these insulating blankets combine high thermal efficiency with a minimum of removal and re-application effort.

Ehret's Asbestos Insulating Blankets are made of two layers of asbestos cloth in self-contained envelope form, between which soft, fluffy asbestos fibres are quilted. The fibres used are 100% pure brown Amosite Asbestos. The type of asbestos cloth used to form the outside of this quilted blanket is dependent upon the temperatures involved.

The edges and seams of Ehret's Asbestos Insulating Blankets are sewed with asbestos thread, and grommets, hooks or rings are fastened on to provide ease of attachment. If desired, the outer surface of this type of insulation can be made of cotton canvas instead of asbestos cloth, but for durability it is recommended that asbestos cloth be used on both sides.

With the exception of the hot oil line blankets, Ehret's Asbestos Insulating Blankets are not stock items. They are made on order to specification, and the size and dimensions of the surfaces to be covered must be furnished, as well as the insulation thickness desired. Irregular shapes and cut-outs can readily be provided.

Recommended thicknesses of this type of blanket insulation are as follows:

Temperature in Degrees F.	Thickness Recommended
Up to 350	1½"
351 to 400	2"
401 to 500	2½"
501 to 600	3" (in 2 layers)
601 to 800	4" (in 2 layers)
801 to 900	4½" (in 2 layers)

TURBINE BLANKETS

Certain parts of steam turbines require frequent inspection or servicing. Asbestos Insulating Blankets are well suited for use on these areas, because in their removal and re-application, the

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adjacent insulation need be in no way disturbed or damaged.

Turbine Blankets are usually applied in two layers of equal thickness, except when the space allowed for insulation by the design of the sheet metal cover is less than 3 inches, in which case a single-layer blanket is used.

OIL FIELD BOILER BLANKETS

Oil field boilers are generally temporary installations, and as such, it is often thought unnecessary to pay for a permanent insulation job. For reasons of fuel economy and in order to obtain the desired service from the boilers it is as necessary to have insulation on oil field boilers as on any other type of boiler. For this service Ehret's Asbestos Insulating Blankets are particularly adaptable. Oil Field Boiler Blankets are usually furnished in one layer.

It is necessary for all boiler and turbine details and dimensions to be furnished and the insulation thickness given before quotations can be made or blankets manufactured. However, recommendations will be furnished on request.

HOT OIL LINE BLANKETS

In the petroleum refining industry frequent inspection of hot oil lines, particularly those which connect the cracking coil with the soaking drums and the various cracking processes, necessitates frequent removal of the insulation. These lines usually consist of a series of bends having radii of not over 2 feet and usually include a great number of valve fittings and flanges. Special removable pipe blankets have been designed for this service and in many instances they are more economical to use than the molded type of insulation, due to the ease of removal and re-application.

On these oil line blankets all edges are beveled for a lap joint and sewed with five-ply asbestos sewing twine, in a special lock stitch. Monel metal hooks for lacing are secured to all longitudinal edges with Monel metal wire and copper discs on approximately 5-inch centers. As the temperatures encountered in hot oil lines may run up as high as 950 degrees F., both sides are made of pure asbestos cloth, weighing approximately 3.3 lbs. per square yard. The quilting is on approximately 9-inch centers with wire inserted asbestos cord and without discs.

Where single-layer blankets are to be used, a 2″ or 3″ thickness is recommended. For double-layer blankets the thicknesses should be 1½″ or 2″ for each layer.

These blankets are made in 3-foot long sections, with a 1-foot section to be used for breaking the joints on 2-layer construction.

Pipe blankets are usually fastened on and left unfinished, but where there is any likelihood of an excessive moisture condition, the outer surfaces should be protected with Ehret's 50-pound asphalt saturated-and-coated roofing felt which can be cut to fit and then wired on over the blankets.

It is necessary that proper measurements be taken and sketches furnished for blankets on ells, crosses, tees and valves.

EHRET'S FIBREFIL INSULATING TAPE

Where hot pipes are subjected to such vibration or mechanical abuse that the use of a sectional type of insulation is not practical, they can be very satisfactorily insulated with a wrapping of Fibrefil Insulating Tape. This material can be repeatedly removed and re-applied without difficulty or damage to the insulation.

Fibrefil Insulating Tape consists of flat tubing made of high quality asbestos cloth which is uniformly filled with slightly felted, resilient asbestos fibres.

The asbestos cloth tubing is, unless otherwise specified, furnished with no coating, but it can be supplied with a waterproof coating that protects one side and both edges from moisture.

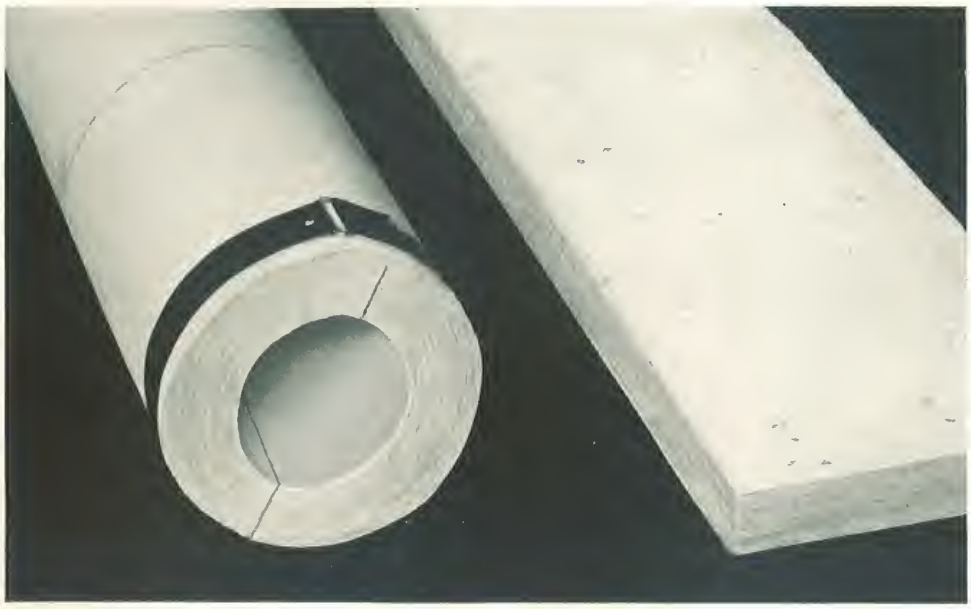
In addition to the regular grade of Fibrefil Tape, which is suitable for use on temperatures up to 500° F., a high-temperature grade is also available for use on surfaces ranging up to 850° F.

Fibrefil Insulating Tape is furnished in 50-foot rolls, 10 rolls to a carton, for the three smaller sizes. The largest tape (4″ x 1″) is furnished in 25-foot rolls, 8 rolls to a carton. All sizes are available in either the plain or waterproof finish.

The following table shows the available sizes of Fibrefil Tape as well as the amount required to cover various sizes of pipe.

LINEAL FEET OF FIBREFIL TAPE REQUIRED
per foot of Straight Piping

Pipe Size	Cross-sectional Size of Tape			
	1 9/16″ x 3/16″	2″ x ¼″	2 3/8″ x 3/8″	4″ x 1″
⅜″	1.75	1.50	....	....
½″	2.00	1.75	1.75	....
¾″	2.50	2.00	2.00	....
1″	3.00	2.50	2.25	....
1¼″	3.75	3.00	2.75	2.25
1½″	4.50	3.50	3.00	2.50
2″	5.25	4.25	3.75	2.75
2½″	....	....	4.50	3.25
3″	....	....	5.25	3.75
3½″	....	....	6.00	4.25



EHRET'S ASBESTOS SPONGE FELT . . .

For service conditions requiring an insulating material that will withstand severe mechanical shock and vibration, the use of Ehret's Asbestos Sponge Felt may be considered. This material consists of laminated sheets of asbestos felt in which finely-ground sponge particles are incorporated to form the dead air spaces which provide insulation characteristics.

With approximately 37 to 42 laminations per inch of thickness, Ehret's Asbestos Sponge Felt has high initial insulation efficiency and a lower tendency to shrink in service. Where rough usage or severe service conditions warrant the use of a laminated type of insulating material, and where surface temperatures do not exceed 700° F., Ehret's Asbestos Sponge Felt may be specified.

Pipe Coverings

Ehret's Asbestos Sponge Felt Pipe Covering is furnished in 3 ft. sections for use on steel and wrought iron pipe sizes from ½" upwards, and for copper pipe tubing having outside diameter of ⅜" to 6⅛" inclusive. These pipe coverings are available in 1", 1½" and 2" thicknesses in single or double layer construction and 2½" and 3" thicknesses in double layer construction only. Special thicknesses of ½", ⅝" and ¾" for the insulation of heating lines on trains are available on special order. All sectional pipe coverings are regularly furnished with canvas jackets and bands.

When used on outdoor or underground pipe lines, weatherproof jackets may be attached to the pipe covering at the factory, or the Durant system of pre-sealed protection may be used as described on other Ehret data sheets.

Accessory materials required for the application of weatherproofing jackets are as follows, for every hundred lineal feet of pipe covering:

Staples—1 lb. of ¾" x ¾" Copperweld.

Lap Cement—(furnished in 1, 5, 25 and 50 gal. containers). Required as follows:

Pipe Size Inches	Insulation Thickness Less than 2"	2" or more
½— 3	1 gal.	1½ gal.
3½— 7	1½ "	2 "
8 —14	2 "	2½ "

Pipe Coverings are usually furnished in crates but are obtainable in cartons up to and including the 5" pipe size.

Sheets and Blocks

Ehret's Asbestos Sponge Felt Sheets and Blocks are obtainable in 36" lengths, and in 6, 9, 12, 18, 24 or 36" widths and in thicknesses from ½" to 4" inclusive. Sheets and Blocks are packed in crates or cartons as desired. Weight of the material is approximately 2½ lbs. per square foot per inch of thickness.

MINIMUM RECOMMENDED THICKNESSES

Temperature of Heated Surface in Degrees F.	PIPE SIZES		
	Under 2"	2" to 4"	4½" and up
Up to 300	1"	1½"	1½"
301 to 400	1½"	1½"	2"
401 to 500	2"	2"	2½"
501 to 600	2"	2½"	3"

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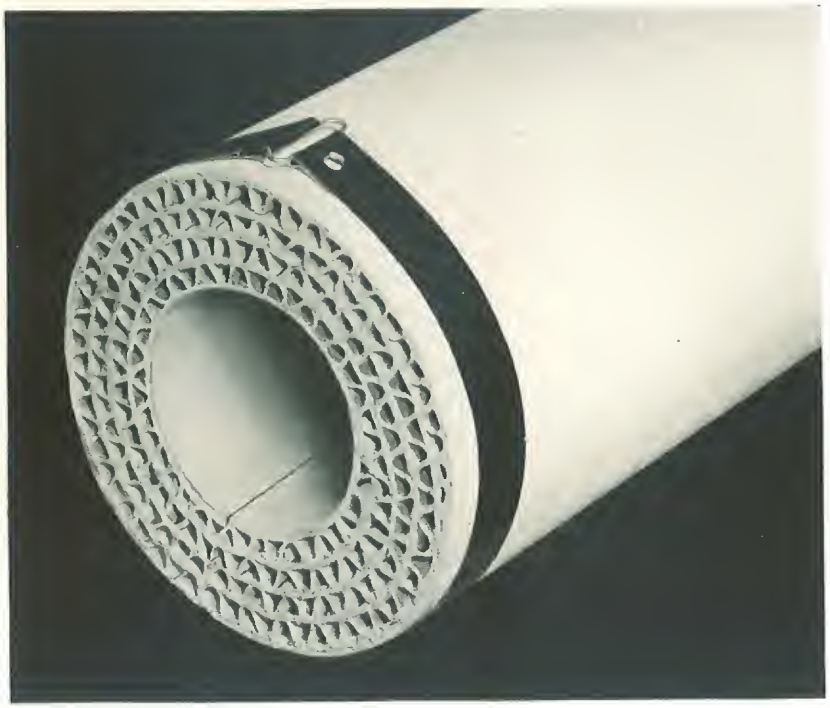
EHRET'S SPONGE FELT PIPE COVERING

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in BTUs per Square Foot of Pipe Surface per Hour per Degree of Temperature Difference between Pipe and Air

Pipe Temperature		170° F.		270° F.		370° F.		470° F.		570° F.	
Temperature Difference		100° F.		200° F.		300° F.		400° F.		500° F.	
Pipe Size	Thick-ness	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %	B. T. U. Loss	Eff. %
1	1	.510	79.60	.563	81.23	.616	82.89	.669	84.58	.722	86.01
	1½	.418	83.28	.475	84.17	.532	85.23	.589	86.43	.647	87.46
	2	.363	85.50	.390	87.00	.417	88.40	.444	89.77	.471	90.87
	2½	.322	87.12	.348	88.40	.374	89.61	.400	90.78	.426	91.74
	3	.302	87.52	.325	89.00	.348	90.33	.370	91.47	.393	92.38
1½	1	.442	81.66	.489	83.14	.536	84.69	.583	86.22	.630	87.47
	1½	.368	84.73	.395	86.40	.412	88.23	.439	89.62	.475	90.55
	2	.308	87.22	.331	88.51	.354	89.88	.377	91.09	.401	92.03
	2½	.272	88.71	.294	90.21	.316	90.97	.338	92.01	.360	92.84
	3	.247	89.75	.266	90.83	.285	91.87	.304	92.81	.324	93.75
2	1	.415	82.34	.444	84.42	.473	86.30	.502	87.93	.531	89.34
	1½	.328	86.04	.355	87.54	.382	88.93	.409	90.17	.435	91.26
	2	.281	88.04	.303	89.37	.325	90.58	.347	91.66	.368	92.61
	2½	.237	89.91	.259	90.91	.281	91.88	.303	92.72	.324	93.51
	3	.222	90.55	.240	91.58	.258	92.52	.276	93.17	.293	94.09
2½	1	.385	83.19	.415	85.07	.445	86.79	.475	88.39	.504	89.74
	1½	.313	86.33	.338	87.84	.363	89.23	.388	90.51	.416	91.53
	2	.267	88.34	.287	89.68	.307	90.89	.327	92.01	.347	93.14
	2½	.228	90.05	.246	91.25	.264	92.16	.282	93.11	.300	94.00
	3	.208	90.91	.223	92.00	.238	92.94	.253	93.81	.270	94.50
3	1	.368	83.64	.396	85.49	.424	87.19	.452	88.78	.482	90.07
	1½	.293	86.98	.316	88.43	.339	89.76	.362	91.01	.387	92.02
	2	.252	88.80	.270	90.11	.288	91.30	.308	92.36	.326	93.28
	2½	.213	90.49	.230	91.58	.247	92.54	.264	93.45	.281	94.21
	3	.192	91.02	.207	92.42	.222	93.30	.237	94.12	.252	94.81
4	1	.341	84.43	.367	86.21	.393	87.87	.419	89.39	.446	90.65
	1½	.278	87.31	.300	88.72	.322	90.07	.344	91.29	.368	92.29
	2	.230	89.50	.247	90.72	.264	91.24	.281	92.89	.298	93.75
	2½	.196	91.05	.211	92.07	.226	93.03	.241	93.90	.257	94.61
	3	.172	92.15	.185	93.05	.198	93.89	.212	94.64	.228	95.32
6	1	.323	84.83	.346	86.64	369	88.71	.392	89.92	.414	91.30
	1½	.252	88.17	.272	89.50	.292	90.82	.312	92.00	.333	92.90
	2	.203	90.47	.218	91.58	.233	92.67	.248	93.36	.265	94.35
	2½	.171	91.97	.185	92.85	.200	93.71	.214	94.50	.227	95.16
	3	.153	92.82	.165	93.63	.177	94.43	.189	95.14	.203	95.67
8	1	.310	85.17	.331	87.07	.352	88.78	.374	90.31	.395	91.52
	1½	.240	88.52	.260	89.46	280	91.08	.300	92.23	.320	93.14
	2	.192	90.81	.207	91.91	.222	92.94	.237	93.87	.252	94.59
	2½	.161	92.30	.175	93.16	.190	93.95	.204	94.45	.216	95.37
	3	.141	93.25	.153	94.03	.165	94.74	.177	95.41	.189	95.94
10	1	.300	85.51	.320	87.41	.340	89.11	.360	90.62	.382	91.76
	1½	.228	89.00	.248	90.24	.268	91.41	.288	92.50	.308	93.36
	2	.184	91.11	.200	92.12	.215	93.11	.230	94.01	.243	94.76
	2½	.154	92.56	.167	93.43	.180	94.23	.194	95.00	.208	95 52
	3	.133	93.58	.145	94.30	.157	95.00	.168	95.63	.180	96.12
12	1	.296	85.60	.316	87.46	.336	89.16	.356	90.66	.375	91.86
	1½	.224	89.10	.243	90.34	.262	91.50	.281	92.60	.301	93.42
	2	.179	91.27	.194	92.31	.210	93.23	.224	94.12	.238	94.84
	2½	.150	92.68	.163	93.53	.174	94.30	.188	95.06	.204	95.57
	3	.130	93.66	.141	94.41	.152	95.10	.162	95.75	.174	96.23

Ehret's Standard Air Cell Pipe Covering 1 inch thick, as shown here, is frequently used on hot water lines.



EHRET'S ASBESTOS CELLULAR PIPE COVERINGS

Ehret's Asbestos Cellular Pipe Coverings are commonly used on hot air, hot water and low pressure steam piping where first costs are of paramount importance. Due to the construction of this type of material it is impossible to obtain as many dead air spaces in these coverings as in 85% Magnesia. However, where high insulating efficiency and long life are not prime factors, asbestos cellular coverings may be used on pipes whose temperatures do not exceed 300° F.

Great improvements have been made in manufacturing methods and Ehret now offers several different types of asbestos cellular pipe coverings, all of which are the same in basic construction but vary mainly in the type of outside finish.

Ehret's Asbestos Cellular Pipe Coverings are made from 6 lb. asbestos papers which are corrugated, dried and then formed into the desired sizes and thicknesses. Each layer or ply of corrugated paper is backed with a layer of flat paper. After forming, coverings are split so that they can be hinged open and applied to the pipe.

The depths of the corrugations of each ply and the number of plies per inch of thickness are important. Insulating efficiency is increased in accordance with the number of dead air spaces in any insulating material. Therefore, the smaller the depths of corrugations and the greater the number of plies, the more efficient the material. Corrugations are made ¼", 1/6" and ⅛" in depth which permits 4, 6 and 8 plies per inch of thickness. Asbestos cellular coverings are furnished in 3-foot lengths, for pipe sizes ranging from ½" to 6".

STANDARD AIR CELL

The outer finish of this type consists of a layer of flat asbestos paper to which is attached a canvas jacket, the flap of which needs but to be pasted down when applied.

Ehret's Standard Air Cell Pipe Coverings are available in three corrugation depths, as follows:

¼" CORRUGATIONS made in—
2 ply (½" thick.)
3 ply (¾" thick.)
4 ply (1" thick.)

1/6" CORRUGATIONS made in—
4 ply and 6 ply

⅛" CORRUGATIONS made in—
6 ply and 8 ply

All of the above are furnished packed in cartons with sufficient bands for applying.

IMPROVED AIR CELL

This type of covering is similar to Standard Air Cell covering except that instead of a canvas pasting jacket, the outside consists of a layer of specially prepared heavy asbestos felt that is light gray in color. This asbestos felt is pre-shrunk to minimize the tendency to shrink in service.

To apply Ehret's Improved Air Cell Coverings, they need only to be placed over the pipe, the bands applied and the staples pressed in to span

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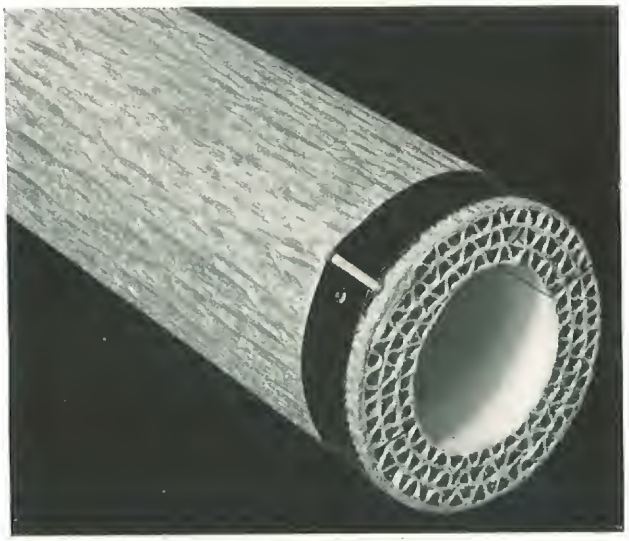
Ehret's Standard Air Cell with ⅛" corrugations

Ehret's Alba-Cel Pipe Covering, 3 ply thick



Ehret's Alumino-Cel Pipe Covering, 3 ply thick

the split seam. Since no canvas jacket or pasting is required, this type of covering can be applied with speed.

These coverings are available only in 3 ply (¾" thick) and 4 ply (1" thick). They are packed in cartons with bands for applying and a sufficient quantity of staples to lock the seams.

ALBA-CEL COVERINGS

The outer finish of Ehret's Alba-Cel Pipe Coverings is superior to that of the asbestos cellular types heretofore described. This finish consists of a white-glaze coated asbestos paper which, in the majority of cases, would be a highly acceptable finish on any insulation job. The outer layer of Alba-Cel is much heavier than that on either the Standard type or Improved type, and offers a greater protection to the insulation itself. These coverings are applied in the same manner as Improved Air Cell.

Alba-Cel Pipe Coverings are widely used in residences and in general hot water and low pressure steam heating work where piping is exposed to view. The finish can be easily and safely cleaned with a damp cloth. Alba-Cel coverings are made only in 3 ply (¾" thick) and 4 ply (1" thick). They are furnished in cartons with sufficient bands and staples.

ALUMINO-CEL PIPE COVERINGS

The outer finish of Ehret's Alumino-Cel Pipe Coverings consists of a prepared heavy asbestos felt which has been crimped in such a way as not to fracture the fibres. This felt is firmly bonded to the outside of the covering and then painted at the factory with an asphalt-base aluminum paint.

Alumino-Cel, like Alba-Cel, is a completely finished covering unit when shipped from the factory, and it is applied in the same manner as Improved Air Cell. The effect of the aluminum finish is both brilliant and pleasing, and aluminum will be found to conform to nearly any surrounding color scheme.

Made only in 3 ply (¾" thick) and 4 ply (1" thick), Alumino-Cel is furnished in cartons with sufficient bands and staples.

PACKAGING

All of the Asbestos Cellular Pipe Coverings listed on this sheet are packed in cartons containing the application accessories noted. These cartons are strong enough to withstand the normal hazards of transportation, yet they are light and easy to handle. Each carton is labeled to identify its contents.

The number of lineal feet of covering per carton and the number of units per carton are given in the packaging table on accompanying data sheet.

PACKAGING DATA

For Ehret's Asbestos Cellular Pipe Coverings

NUMBER OF LINEAL FEET AND NUMBER OF SECTIONS PER CARTON

Pipe Size	Standard Air Cell						Improved Air Cell, Alba-Cel and Alumino-Cel			
	2-Ply ½ inch Thick		3-Ply ¾ inch Thick		4-Ply 1 inch Thick		¾ inch Thick		1 inch Thick	
	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections
½″	180	60	120	40	81	27	120	40	81	27
¾″	144	48	102	34	69	23	102	34	69	23
1″	117	39	81	27	60	20	81	27	60	20
1¼″	90	30	69	23	54	18	69	23	54	18
1½″	72	24	60	20	45	15	60	20	45	15
2″	60	20	45	15	36	12	45	15	36	12
2½″	45	15	36	12	33	11	36	12	33	11
3″	45	15	36	12	30	10	27	9	21	7
3½″	42	14	30	10	27	9	21	7	18	6
4″	39	13	27	9	24	8	18	6	18	6
5″	27	9	21	7	15	5	12	4	9	3
6″	21	7	15	5	12	4	9	3	6	2

EHRET'S ASBESTOS CORRUGATED PAPER

This material is used for the insulation of hot air heater casings and furnace pipes. For all ordinary conditions two or three wrappings or layers of this paper is sufficient.

Ehret's Asbestos Corrugated Paper is made by cementing a flat sheet of asbestos paper to another sheet of 6-lb. asbestos paper which has been corrugated, thus forming a flexible insulating material in roll form. The depth of the corrugations is usually ¼″, but if desired, this material is available with 1/6″ or ⅛″ corrugations. It is easily applied by wrapping around the equipment to be insulated, until the required thickness is obtained, and fastened with wire loops. The paper should be applied with the flat surface outside so as to afford a smooth finish. To provide a neat appearance, Ehret's Asbestos Paper Tape should be pasted over the joints.

The standard roll of ¼″ thick Corrugated Paper contains 250 sq. ft., is 36″ wide and is packed in a carton. Rolls containing 500 square feet are also obtainable. Weight is approximately 50 lbs. per 250 sq. ft. roll.

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EHRET
INSULATIONS

EHRET'S STANDARD AIR CELL PIPE INSULATION

¼" corrugations

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in BTUs per Square Foot of Pipe Surface per Hour per Degree Temperature Difference between Pipe and Air

Pipe Temperature			120° F.		170° F.		220° F.		270° F.	
Temperature Difference			50° F.		100° F.		150° F.		200° F.	
Pipe Size	Thickness		BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
	No. of Plies	Inches								
½"	—	Bare	2.480	—	2.700	—	2.950	—	3.210	—
	3	¾"	.970	60.90	1.030	61.85	1.090	63.05	1.150	64.17
	4	1"	.850	65.72	.905	66.50	.960	67.46	1.015	68.40
	6	1½"	.738	70.24	.782	71.04	.826	72.00	.870	72.90
¾"	—	Bare	2.360	—	2.570	—	2.800	—	3.070	—
	3	¾"	.877	62.84	.935	63.62	.993	64.54	1.051	65.78
	4	1"	.776	67.12	.830	67.71	.884	68.43	.939	69.41
	6	1½"	.658	72.12	.698	72.84	.738	73.64	.778	74.66
1"	—	Bare	2.290	—	2.500	—	2.730	—	3.000	—
	3	¾"	.810	64.63	.860	65.60	.911	66.63	.962	67.93
	4	1"	.714	68.82	.760	69.60	.806	70.49	.852	71.60
	6	1½"	.580	74.68	.620	75.20	.660	75.83	.700	76.67
1¼"	—	Bare	2.240	—	2.450	—	2.680	—	2.940	—
	3	¾"	.755	66.29	.800	67.35	.845	68.48	.890	69.72
	4	1"	.648	71.08	.690	71.84	.732	72.80	.774	73.68
	6	1½"	.534	76.16	.568	76.81	.602	77.54	.636	78.40
1½"	—	Bare	2.200	—	2.410	—	2.640	—	2.900	—
	3	¾"	.697	68.32	.745	69.10	.793	70.00	.841	71.00
	4	1"	.620	71.81	.660	72.61	.700	73.49	.742	74.41
	6	1½"	.509	76.87	.541	77.55	.573	78.30	.605	79.14
2"	—	Bare	2.150	—	2.350	—	2.580	—	2.850	—
	3	¾"	.652	69.67	.695	70.43	.738	71.39	.781	72.59
	4	1"	.579	73.07	.615	73.84	.651	74.77	.687	75.92
	6	1½"	.457	78.75	.488	79.24	.519	79.89	.550	80.70
2½"	—	Bare	2.090	—	2.290	—	2.520	—	2.780	—
	3	¾"	.609	70.86	.651	71.57	.693	72.50	.735	73.60
	4	1"	.543	74.01	.578	74.80	.613	75.68	.648	76.69
	6	1½"	.439	79.04	.469	80.00	.499	80.20	.529	80.90
3"	—	Bare	2.050	—	2.250	—	2.470	—	2.730	—
	3	¾"	.582	71.61	.622	72.36	.662	73.20	.702	74.29
	4	1"	.516	74.83	.550	75.56	.584	76.36	.620	77.29
	6	1½"	.413	79.85	.442	80.36	.471	80.92	.500	81.69
3½"	—	Bare	2.020	—	2.220	—	2.430	—	2.690	—
	3	¾"	.567	71.93	.605	72.75	.643	73.54	.681	74.70
	4	1"	.501	75.20	.533	76.00	.565	76.80	.597	77.81
	6	1½"	.405	80.00	.430	80.63	.455	81.28	.480	82.16
4"	—	Bare	2.000	—	2.190	—	2.400	—	2.660	—
	3	¾"	.535	73.25	.575	73.74	.615	74.40	.650	75.38
	4	1"	.476	76.20	.510	76.71	.544	77.34	.568	78.65
	6	1½"	.395	80.25	.415	81.05	.440	81.67	.465	82.52

EHRET'S AIR CELL SHEETS AND BLOCKS

Ehret's Air Cell Sheets and Blocks are sometimes used for insulating low pressure boilers, warm air ducts, dryers and similar medium and low temperature equipment. They are also used as an insulation in the partitions of ovens and stoves, and as duct insulation in air-conditioning equipment. They are not recommended for use above 300° F. Efficiency and Heat Loss table is given on the other side of this sheet.

This insulating material is made of alternate layers of flat and corrugated asbestos papers, the corrugated layers being crossed at right angles to make the sheets stronger and more durable. The layers are firmly cemented together and built up to the desired thickness. A smooth finish is furnished on one side, but can be supplied on both sides if desired.

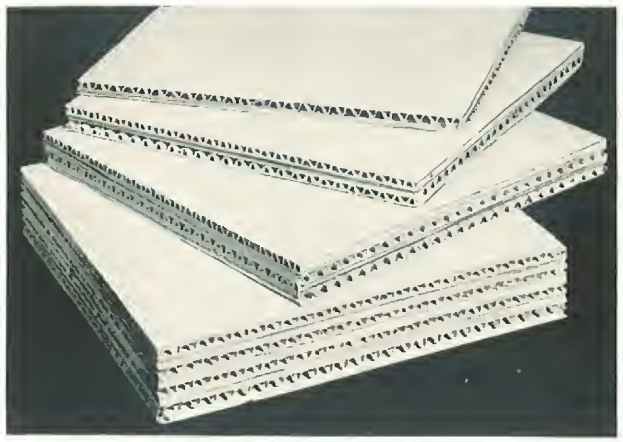
This material is available with corrugations of three different depths, namely ¼", 1/6" and ⅛".

Sizes of sheets and blocks are as follows:

Widths—6", 9", 12", 18" and 36"
Lengths—36" and 72"
Thicknesses—any, from ½" to 4" inclusive

Approximate weights per square foot per inch of thickness of this material are as follows:

¼" corrugations—1.0 lbs.
1/6" " —1.3 lbs.
⅛" " —1.5 lbs.



Ehret's Air Cell Sheets and Blocks are packed in cartons or crates, as desired. Carton contents (of the ¼" corrugation material) are given on the other side of this sheet.

EHRET'S PANEL-BOARD SHEETS

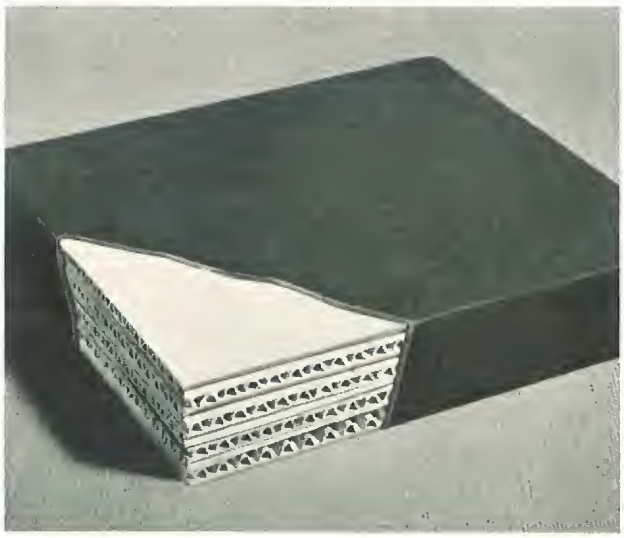
Where large, structurally-strong sheets of insulation are required, Ehret's Panel-Board Sheets may well be specified. They are frequently used to form the exposed surfaces of ovens and dryers, usually being hung or supported in a light structural framework.

Ehret's Panel-Board Sheets are formed by cementing together layers of closely corrugated, strong asbestos paper to the desired total thickness. Both sides and all edges are sealed and protected with heavy asbestos paper and the whole unit is then thoroughly impregnated with a heat-resisting and hardening compound. When dry, the sheets are not only very stiff and rigid but all outer surfaces are very hard and will resist damage which might be caused by ordinary bumping or abrasion. In cases where protection from severe mechanical shock is required the surfaces should be protected with sheet metal.

Ehret's Panel-Board Sheets are available in the following two types:

Type L—for temperatures up to 250° F.
Type H—for temperatures between 250° F. and 500° F.

Although both types of this material are highly moisture-resistant, Type L is treated so as to make it practically waterproof.



Ehret's Panel-Board Sheets are available in sizes of 36" x 36", 36" x 72" and 36" x 84". Available thicknesses range from 1" to 4" in ½" increments. Because of the process of hardening these sheets, the dimensions of the sheets may vary slightly from those here given. Tolerances of ¼" in width and length, and ⅛" in thickness, should be allowed for.

Printed in U. S. A. 11-38

EHRET
INSULATIONS

EHRET'S AIR CELL SHEETS AND BLOCKS

EFFICIENCIES and HEAT LOSSES

Heat Losses are given in BTUs per Square Foot of Pipe Surface per Hour per Degree Temperature Difference between Pipe and Air

Temperature Hot Surface		120° F.		170° F.		220° F.		270° F.		320° F.		370° F.	
Temperature Difference		50° F		100° F.		150° F.		200° F.		250° F.		300° F.	
Thickness		BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %	BTU Loss	Eff. %
No. of Plies	Inches												
Bare Surface		1.750	——	1.920	——	2.110	——	2.350	——	2.610	——	2.900	——
		¼" CORRUGATIONS											
2	½"	.450	74.30	.490	74.50	.535	74.70	.575	75.53	.615	76.50	.655	77.44
3	¾"	.395	77.45	.430	77.60	.465	78.00	.495	78.90	.525	79.90	.560	80.70
4	1"	.352	79.90	.382	80.10	.415	80.33	.449	80.90	.474	81.85	.498	82.80
6	1½"	.282	83.90	.300	84.40	.318	84.90	.337	85.65	.354	86.44	.372	87.16
8	2"	.219	87.50	.234	87.80	.248	88.25	.263	88.81	.278	89.35	.292	89.93
		1/16" CORRUGATIONS											
3	½"	.414	76.34	.451	76.51	.487	76.92	.523	77.75	.560	78.54	.598	79.38
6	1"	.331	81.08	.356	81.46	.381	81.94	.406	82.72	.431	83.48	.454	84.35
9	1½"	.265	84.85	.280	85.41	.295	86.02	.310	86.82	.325	87.54	.340	88.27
12	2"	.200	88.57	.214	88.86	.227	89.24	.240	89.78	.253	90.31	.266	90.83
		⅛" CORRUGATIONS											
4	½"	.398	77.27	.442	76.98	.467	77.86	.492	79.06	.517	80.19	.540	81.38
8	1"	.310	82.28	.338	82.39	.356	83.13	.374	84.09	.392	85.00	.410	85.86
12	1½"	.247	85.88	.266	86.14	.276	86.92	.287	87.79	.298	88.60	.308	89.38
16	2"	.194	88.89	.205	89.32	.221	89.52	.228	90.30	.234	91.03	.240	91.72

PACKAGING DATA

Ehret's Air Cell Sheets and Blocks

NUMBER OF SHEETS AND SQUARE FEET PER CARTON

CARTON CONTENTS	Thickness of Covering						
	½" Thick (2 Ply)	¾" Thick (3 Ply)	1" Thick (4 Ply)	1¼" Thick (5 Ply)	1½" Thick (6 Ply)	1¾" Thick (7 Ply)	2" Thick (8 Ply)
Square Feet per Carton	198	153	99	81	63	54	54
No. of Sheets 36" x 36"	22	17	11	9	7	6	6
No. of Sheets 12" x 36"	66	51	33	27	21	18	18
No. of Sheets 6" x 36"	132	102	66	54	42	36	36

EHRET'S FLEXIBLE RANGE BOILER JACKETS

If domestic range boilers or hot water tanks are covered with an insulating jacket, considerable fuel will be saved and the appearance of the equipment will be greatly improved. Ehret's Flexible Range Boiler Jackets are made expressly for this service, and, in addition to having good insulation efficiency, they are low in cost, easy to apply and are available in a number of attractive finishes.

Where hot water tanks are exposed to view, as is frequently the case in modern home construction, an Ehret Flexible Range Boiler Jacket will change an unsightly tank into an attractive looking piece of domestic equipment. The heat savings effected by the use of one of these jackets will more than pay for its cost, and water can be heated faster and kept hot longer, at less cost, than in uninsulated boilers.

Ehret's Flexible Range Boiler Jackets are constructed of 3 layers of ¼" corrugated asbestos paper, covered with an asbestos felt outer finish. Total thickness is approximately ⅞". These standard jackets are available for either horizontal or vertical boilers. There is no difference in the jackets themselves for the two types of boilers, but the insulation furnished for the ends will differ. Unless otherwise specified, jackets for vertical boilers will be furnished, including sufficient insulating cement to cover the top of the boiler. Horizontal boiler jackets will be furnished on request, with either Air Cell Board discs or asbestos cement insulation, as desired, for the ends.

Finishes

Unless otherwise specified, Ehret's Flexible Range Boiler Jackets are furnished with a light gray, crinkled asbestos felt outer surface. This type of jacket does not usually require painting but it can be painted to specified color at the factory or on the job. Other types of finish are available, such as the Ehret Alumino finish, and a smooth painted or glazed surface can be supplied.

Sizes

The standard sizes of Ehret's Flexible Range Boiler Jackets listed in the accompanying table are available in the various finishes described above. Other sizes will be furnished on request.

Packaging

These jackets are made in 2 sections, each of which is half the length of the tank to be covered. The sections are smoothly split along one side and are nested in the carton. Each sturdy carton contains one jacket with accessories consisting of standard or specified insulation for the end of the boiler, as well as sufficient bands and aluminum staples for application.

RANGE BOILER JACKETS

Boiler Size		Capacity in Gallons
Diameter	Length	
12"	60"	30
14"	60"	40
16"	60"	52
18"	60"	66
20"	60"	82
22"	60"	100
24"	60"	120
24"	72"	144

SAVINGS EFFECTED BY INSULATING HOT WATER TANKS WITH EHRET'S FLEXIBLE RANGE BOILER JACKETS

(Based on temperatures of 170° F. for water and 70° F. for air)

Capacity of Tank in Gallons	Heat Losses Total BTUs per Hr.		Heat Savings Due to Insulation	Per Cent Heat Saved
	Bare	Insulated	BTUs per Hr.	
30	3690	912	2778	75.3
40	4182	1025	3157	75.5
52	4872	1184	3688	75.7
66	5555	1337	4218	75.9
82	6130	1464	4666	76.1
100	6800	1612	5188	76.3
120	7562	1778	5784	76.5
144	8536	1980	6556	76.8

Printed in U.S.A. 2-39

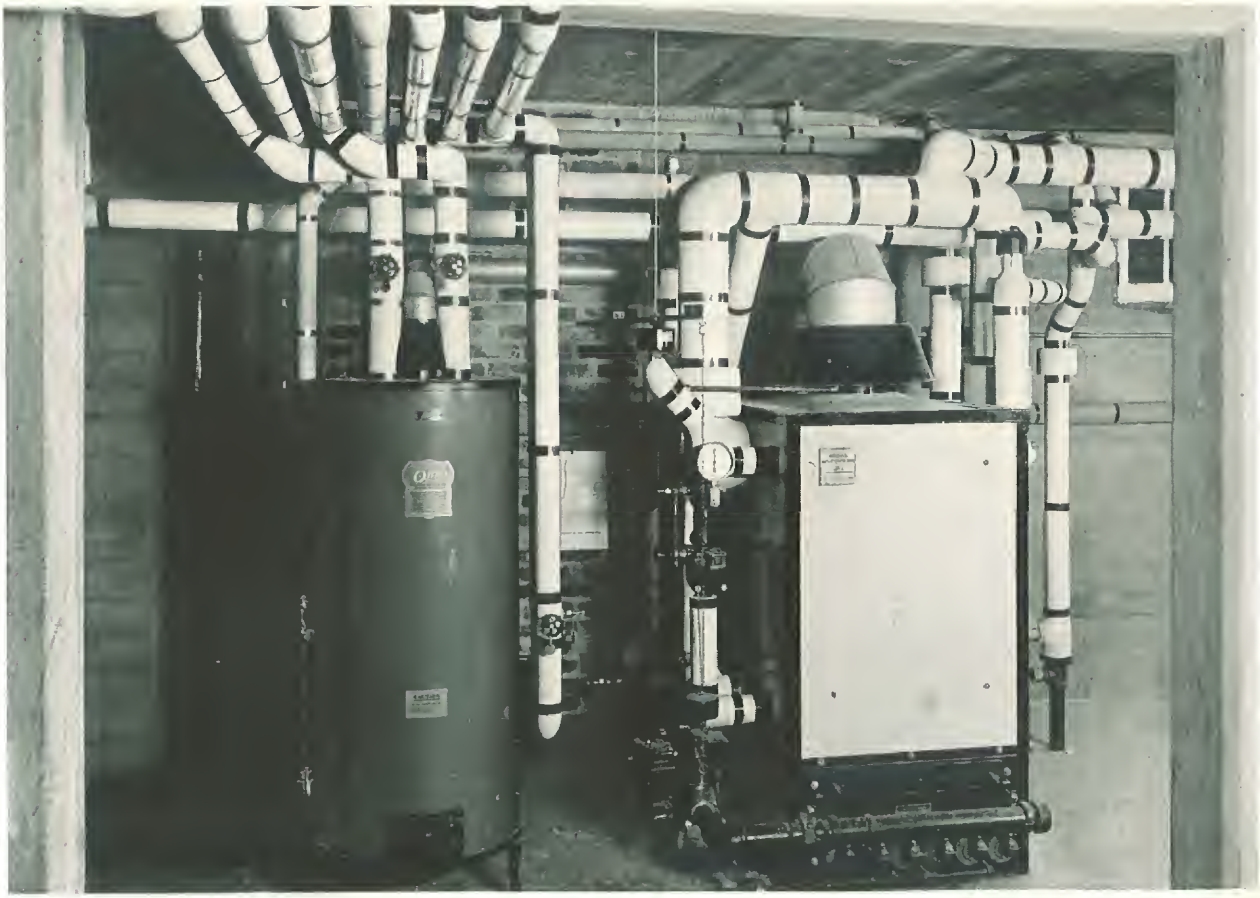
EHRET
INSULATIONS

EHRET'S AIR CELL INSULATIONS

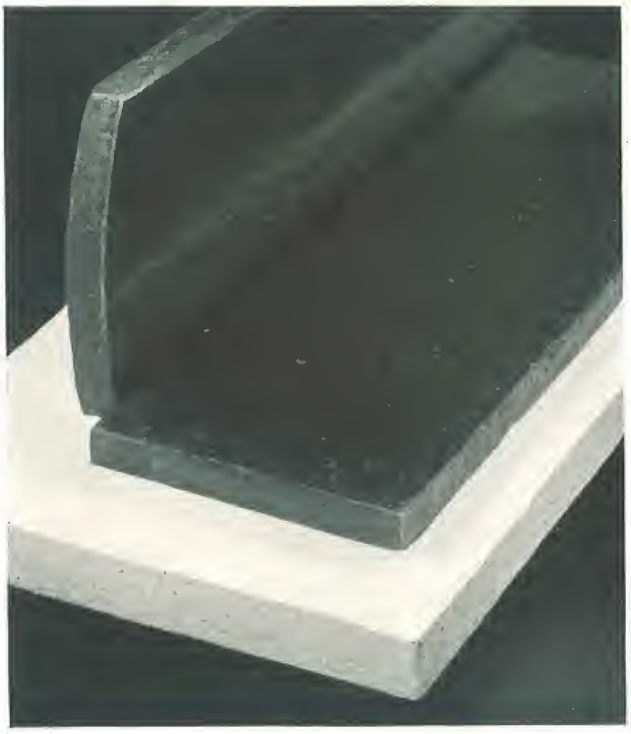
. . . save domestic fuel dollars and improve the appearance of piping and equipment.

At the Right, a Flexible Range Boiler Jacket is shown being applied to a horizontal hot water tank.

Below, hot and cold water service piping, as well as the domestic heating plant, look better and operate more efficiently with Wool Felt and factory finished Air Cell insulations.



EHRET'S ASBESTOFIBRE FELTED SHEETS



For services requiring an insulating material that has special characteristics of structural strength and durability, Ehret's Asbestofibre Felted Sheets are admirably suited. Although this material is usually specified because of its strength and permanency, it is frequently used because it is available in large size sheets.

Ehret's Asbestofibre Felted Sheets are composed mainly of firmly felted, strong asbestos fibres. This material is homogeneous and dimensions of the sheets are held to close tolerances.

Three types of Asbestofibre Felted Sheets are available, as follows:

CANADIAN TYPE:—The fibre used for this material is pure, high quality Canadian Asbestos. This Canadian type material is more compact and more uniform than either the Amosite or Vitrified types, and has greater mechanical strength. On account of the ability of this type of material to withstand mechanical shock, it is suitable for use as boiler tube door insulation and other such purposes. Manufacturers of small boilers and special equipment find this grade of material very handy. It may be made up to specified dimensions, at the factory, so that it is ready to install on the equipment with a minimum of labor and jointing.

The weight of this material is approximately 3½ pounds per square foot per inch of thickness.

AMOSITE TYPE:—Carefully processed, long, brown, Amosite Asbestos fibre is used to form the Amosite type of sheets. While not having as much mechanical strength as the Canadian type, it combines the advantages of lightness with a somewhat higher efficiency. It is not as rigid as the Canadian type and it is usually necessary to support these sheets in some manner. A principal use of the Amosite type sheets is as an insulating lining between metal sheets, or between brick linings and metal casings, as in gas heated equipment. Another common use for this material is for insulating air cooled boiler walls. Also, panels may be fabricated by bolting together Ehret's Asbestos Millboard or Asbestos Lumber with a layer of Asbestofibre Felted Sheet between.

The weight of this material is approximately 1¾ pounds per square foot per 1 inch of thickness.

VITRIFIED TYPE:—This type of Asbestofibre Felted Sheet is particularly well suited for use as a stack and flue lining. It is similar to the Amosite type, although it contains a slight portion of the Canadian Asbestos fibre in order to give the resultant product more mechanical strength than the Amosite type.

Before being placed in the dryers, during the manufacturing process, the block undergoes a vitrifying operation which produces a hard, stiff insulation which will withstand severe shock.

The weight of this material is approximately 2½ pounds per square foot per inch of thickness.

Sizes and Thicknesses

Ehret's Asbestofibre Felted Sheets are furnished flat or curved and in 24″ x 36″, 12″ x 36″ and 6″ x 36″ sheet sizes. Standard thicknesses are 1″, 1½″ and 2″, but thicknesses are obtainable from ½″ to 4″ inclusive. Special or irregular shapes can be easily made to order upon the receipt of complete details including blue prints or templates. This applies to all three types.

The following table shows the thermal conductivities of the 3 different types of Ehret's Asbestofibre Felted Sheets. Figures given are in BTUs.

ASBESTOFIBRE FELTED SHEETS

MEAN TEMP. of the material in deg. F.	CONDUCTIVITIES in BTUs		
	Canadian Type	Amosite Type	Vitrified Type
400	0.72	0.66	0.68
600	0.82	0.76	0.78
800	0.91	0.85	0.87
1000	1.01	0.94	0.96
1200	1.11	1.03	1.06
1400	1.21	1.12	1.15

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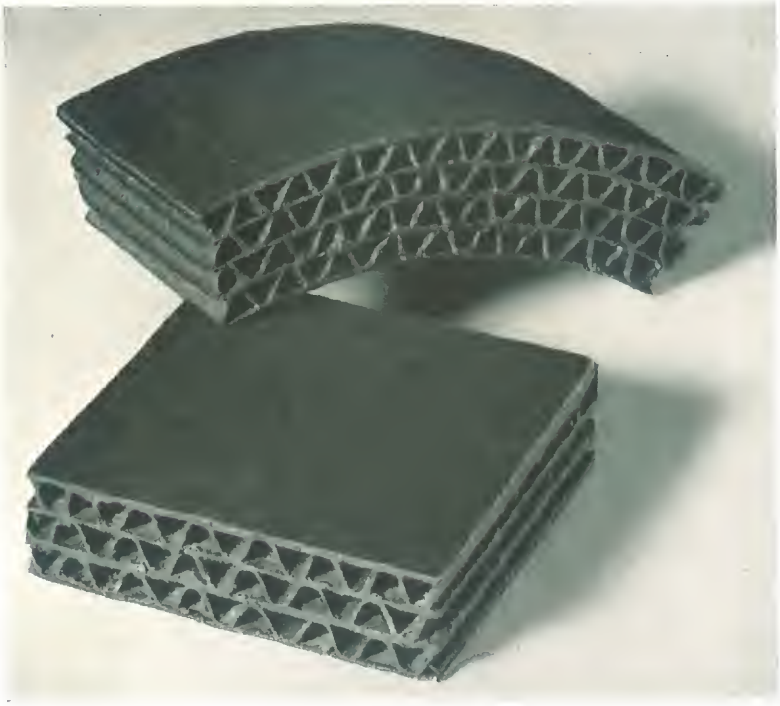
EHRET
INSULATIONS

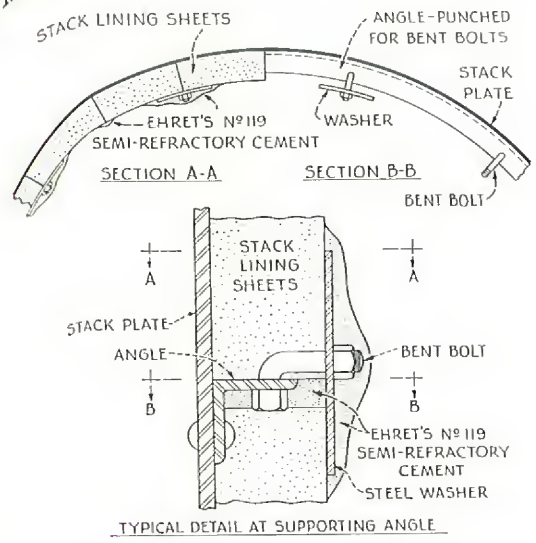
TEMPERATURES UP TO 1100° F.



EHRET'S FYRBESTOS SHEETS

The chief use of Ehret's Fyrbestos Sheets is in lining steel stacks. Without such protection the inside surfaces of the steel stack are exposed to the corrosive action of the flue gases, which, in a comparatively short time may penetrate clear through the steel and completely ruin the stack. The insulating effect of the Ehret's Fyrbestos Sheets will keep most of the heat in the flue gas, causing it to ascend at greater velocity and thereby increasing the draft through the combustion chamber.

In making Fyrbestos Sheets, strong, high quality asbestos paper is first deeply corrugated and then cemented on one side to a heavy sheet of flat asbestos paper. These double sheets are then laminated, or built up one over the other, to the desired thickness and securely cemented together. The completed units are then thoroughly impregnated with a waterproof, fire-proof compound. When dry the result is a very light weight but hard and durable sheet with great structural and mechanical strength. The material is absolutely waterproof and is unaffected by temperatures up to 1100 degrees F. In addition to being perfectly fire-proof, Fyrbestos Sheets are immune to the chemical action of combustion gases.



This detail illustrates the method of applying Ehret's Asbestofibre or Fyrbestos Sheets to the inside of a steel stack.

The comparatively high thermal insulation value of Ehret's Fyrbestos Sheets is indicated by the thermal conductivities given in the table below.

EHRET'S FYRBESTOS SHEETS	
MEAN TEMPERATURE of the material in deg. F.	CONDUCTIVITIES in BTUs
200	.80
400	1.00
600	1.20
800	1.40
1000	1.60

Sizes and Thicknesses

Fyrbestos is regularly furnished in flat sheets 36″ x 6″, 36″ x 36″ and 36″ x 72″, in curved sheets 24″ x 36″—and in thicknesses of 1″—1¼″—1½″—1¾″—2″—2½″ and 3″. Other sizes will be furnished on special order.

Fill insulations are readily poured into air spaces in the walls of brick or metal kilns or ovens.

EHRET'S FILL INSULATIONS . . .

EHRET'S DUROCEL FILLS

The basic material from which Ehret's Durocel Fill Insulations are made is diatomaceous earth. This natural substance, which is also known as diatomaceous silica, kieselguhr and infusorial earth, is composed of the remains or skeletons of very minute organisms called diatoms. In the remote past, countless numbers of these diatoms lived and died in the sea, and their remains formed huge deposits on the ocean floor. Geological changes brought some of these deposits up out of the ocean, and the resulting rock-like formations provide the basic material from which Durocel Fills are made.

Since this diatomaceous material is composed mainly of silica compounds, it can be exposed to relatively high temperatures without suffering any change. The shapes of the individual particles of which this basic material is composed are such as to contain multitudinous microscopic entrapped air spaces both within and between the particles themselves. Consequently, this natural material has insulating qualities approaching those of 85% Magnesia.

Two types of Durocel material are available, namely, Durocel Fill and Durocel Calcined Fill. The major difference between these two types is the upper temperature limits for which they are best suited. The following descriptions of the characteristics of those two types of material will assist in making a selection for a particular use.

Durocel Fill

For Temperatures up to 1600° F.

In the manufacture of Ehret's Durocel Fill, the diatomaceous earth is carefully milled to produce a light, powder-like product of the desired characteristics. Due to the extremely light weight of this material, it has high thermal insulation value.

Ehret's Durocel Fill is available in two grades, namely—Coarse Durocel Fill and Fine Durocel Fill. Both grades are made from the same material and differ only in the degree to which milled.

Coarse Durocel Fill, when properly packed into an installation, will weigh about 18 pounds per cubic foot. Fine Durocel Fill, which is slightly higher in insulating efficiency, will weigh about 13 pounds per cubic foot under the same conditions.

In using either grade of Ehret's Durocel Fill, greater density can be obtained by dampening the material before it is poured and tamped into place. A recommended method is to sprinkle the material while in the bags, with water, about a day before the material is to be used.

When the surface of Durocel Fill is to be exposed, such as is the case when poured onto the tops of ovens, dusting can be prevented by sprinkling lime or portland cement onto the exposed surface of the fill, to act as a binder.

Ehret's Durocel Fill is packed in burlap bags containing 100 pounds each.

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Durocel Calcined Fill

For Temperatures up to 2100° F.

Ehret's Durocel Calcined Fill is a very effective and durable heat insulation material, composed of diatomaceous earth which has been calcined at a high temperature to insure that it will withstand 2100 degrees F. without shrinkage. The calcined diatomaceous earth is very coarsely granulated, containing enough fines to produce a uniform mass without any large voids. It is so graded that 100% will pass through a 3-mesh screen and not more than 48% through an 8-mesh screen. When properly packed it will weigh about 26 pounds per cubic foot. It will pass the U. S. Navy Department Specification No. 32 E 2a.

Ehret's Durocel Calcined Fill is used loose, without any bonding material, but can also be mixed with portland cement to make an insulating concrete. (For insulating concrete, see Data Sheet No. 134). Due to its excellent refractory characteristics it is recommended as a fill insulation for use in the high temperature field. It can be poured over tops or into wall or base spaces of heated equipment where a loose material is more desirable than solid insulation.

It is put up in burlap bags with a net weight of 100 pounds each.

Ehret's Durocel Calcined Fill is used very successfully on many types of high temperature equipment, including the following:—

Brick, Tile and Pottery Kilns
Open Hearth Regenerator Walls and Roofs
Open Hearth Fan-Tail Roofs
Open Hearth Slag Pocket Walls

EHRET'S HEAT-SEAL WOOL FILL

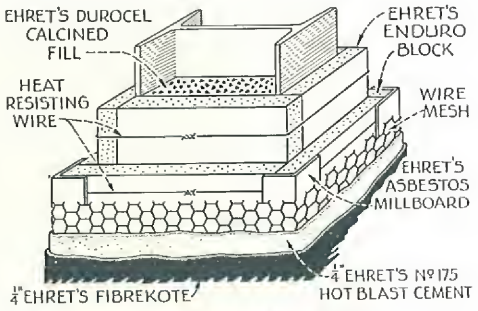
For Temperatures up to 1100° F.

This is a fill insulation composed of specially treated fibre, containing only natural mineral materials. It is absolutely fireproof, vermin-proof, non-corrosive and will not mold or decay. It has a very soft texture and perfectly free from dust and from hard or sharp particles.

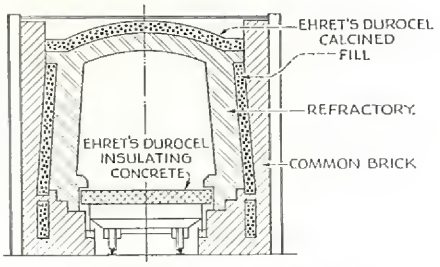
This material is available in two forms, namely—loose and granular. The material in both forms is the same but the loose form closely resembles raw wool fibres while the granular form resembles little pellets of the same material.

Ehret's Heat-Seal Wool in the loose form is easily worked and packed into place by hand. It will cling into recesses and remain in position. It is furnished in bags containing 35 lbs. each. Each bag contains enough material to properly insulate about 5½ cubic feet of space.

The granular form of Ehret's Heat-Seal Wool can be poured into place and is frequently used to fill spaces that are not accessible for hand-packing. It is furnished in bags containing 40 pounds each, and each bag contains enough material to properly insulate about 6½ cubic feet of space.



PROTECTION OF STEELWORK



CERAMIC KILN-TUNNEL TYPE

Typical applications of Ehret's Fill Insulations

EHRET'S VALCULITE FILL

For Temperatures up to 1500° F.

Manufactured from expanded mica, this material is very light in weight, has high insulation value and never deteriorates in use. The particles being soft and loose in character, Valculite Fill is easily poured into narrow spaces or spread over large surfaces. It has no affinity for silica refractory brick and is an ideal insulation for use over silica brick furnace roofs.

Several grades of Valculite Fill are available. The following table gives the screen sizes of the various grades of Valculite Fill, as well as the approximate weights, per cubic foot, of the material when properly packed into place.

VALCULITE FILL		
Grade Name	Screen Size	Approximate Weight
S—1 (coarse)	— ½ + ¼	4.5—5.5 lbs.
S—2 (medium)	— ¼ + 10	5.5—6.5 lbs.
S—2 (fine)	— 10 + 28	7—8 lbs.
Steel Mill	{ — ½ + ¼ / — ¼ + 10 }	5—6 lbs.

The thermal insulating characteristics of the finer grades are better than those of the coarser grades, but the coarser sizes of material are slightly easier to pack and install.

Valculite Fill insulations are packed in paper bags containing 4 cubic feet of fill and weighing 25 pounds, and also in burlap bags containing 2 and 3 cubic feet of the material.

Tamping and finishing Ehret's Durocel Insulating Concrete for an annealing oven door that is to withstand temperatures up to 1750° F.

EHRET'S DUROCEL INSULATING CONCRETE

Insulating concrete is used where a monolithic material of great compressive strength and good thermal efficiency is required. Since it can be poured into place and, when hardened, possesses approximately the strength and most of the characteristics of an ordinary concrete, the uses of Durocel Insulating Concrete are wide and varied. Temperatures as high as 1800° F are normally permissible with this material.

In addition to being used as a heat insulation for or on equipment including foundations, bases, hearths, walls, roofs, housings and doors, insulating concrete is also used as fireproofing on structural steel work. For example, in the oil and metals industries, structural steel work that is exposed to heat or the possibility of fire is frequently encased in insulating concrete so as to protect against weakening, warping or failure of the steel structure. One outstanding advantage of insulating concrete is that, when poured, the structure is monolithic, with no cracks to permit the leaking of hot gases or the infiltration of air.

Ehret's Durocel Insulating Concrete has excellent mechanical strength and insulating efficiency, and it is easy to mix, handle and install. It is made by mixing Ehret's Durocel Calcined Aggregate with portland cement and water. This aggregate consists of properly proportioned amounts of various sized particles of calcined diatomaceous earth.

Mixing

In mixing the concrete, the dry ingredients in the proportion of 4 parts of Durocel Calcined Aggregate to 1 part of portland cement (by volume), should be thoroughly worked together. Sufficient water should then be added to give the mix a consistency such that, when squeezed in the hand, it will form a comparatively dry ball. Excess water should be avoided because its use is detrimental to the final characteristics of the concrete.

When cast into forms or recesses Ehret's Durocel Insulating Concrete should be carefully tamped so as to completely fill the entire space to a uniform density. The wet material may also be applied with a cement gun to large steel or brick surfaces. The concrete will set hard in 24 hours which permits masonry superstructure or other construction to follow immediately thereafter.

The weight of Ehret's Durocel Insulating Concrete when properly mixed, tamped, set and dried, is approximately 48 pounds per cubic foot. Each cubic foot of the dried concrete should contain approximately 28 pounds of the Durocel Calcined Aggregate and 20 pounds of portland cement.

Packaging

Ehret's Durocel Calcined Aggregate is packed in burlap bags of 100 pounds each, and it can be stored indefinitely with no deterioration or loss of insulating value.

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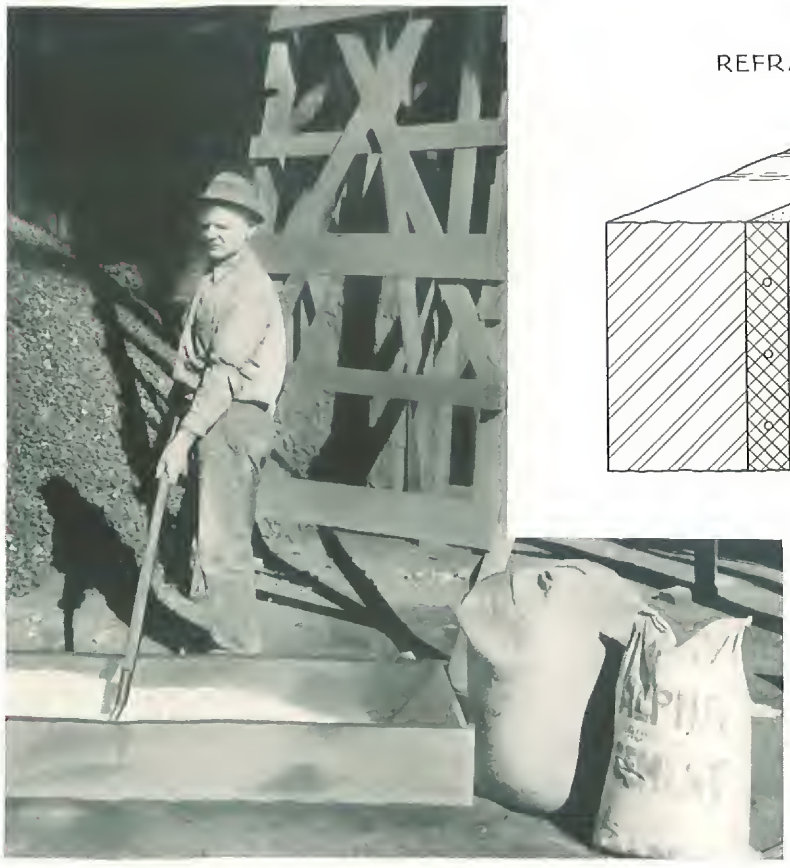
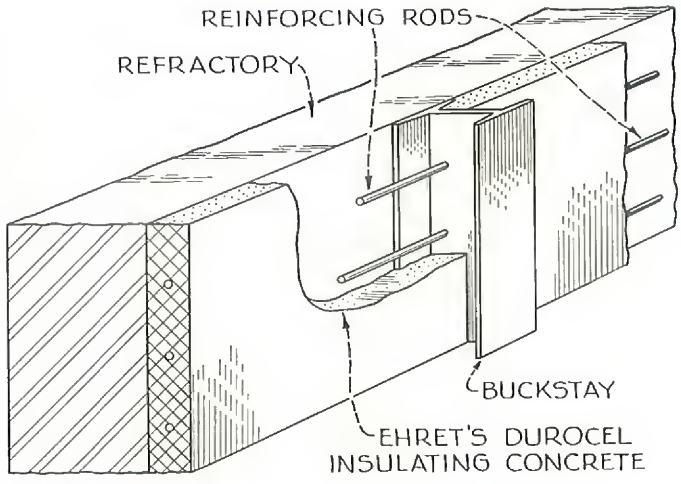
HEAT LOSSES THROUGH
EHRET'S DUROCEL INSULATING CONCRETE
AND VARIOUS WALL CONSTRUCTIONS

Heat Losses are given in total BTUs per Square Foot per Hour

Wall Thickness		Hot Surface Temperature—Deg. F.				
Fire Brick	Durocel Insulating Concrete	800	1200	1600	2000	2400
——	4″	295	510	725	940	——
——	6″	200	350	500	650	——
——	8″	155	270	385	500	——
——	10″	130	220	310	400	——
——	12″	110	135	260	285	——
——	14″	95	110	225	240	——
4½″	4″	220	380	540	700	——
4½″	6″	170	295	420	545	——
9″	4″	190	320	470	620	770
9″	6″	150	260	370	480	590
9″	8″	120	210	300	390	480
13½″	4″	160	275	390	505	620
13½″	6″	130	230	330	430	530
13½″	8″	105	190	275	360	445

TYPICAL INSULATING CONCRETE APPLICATION DETAILS





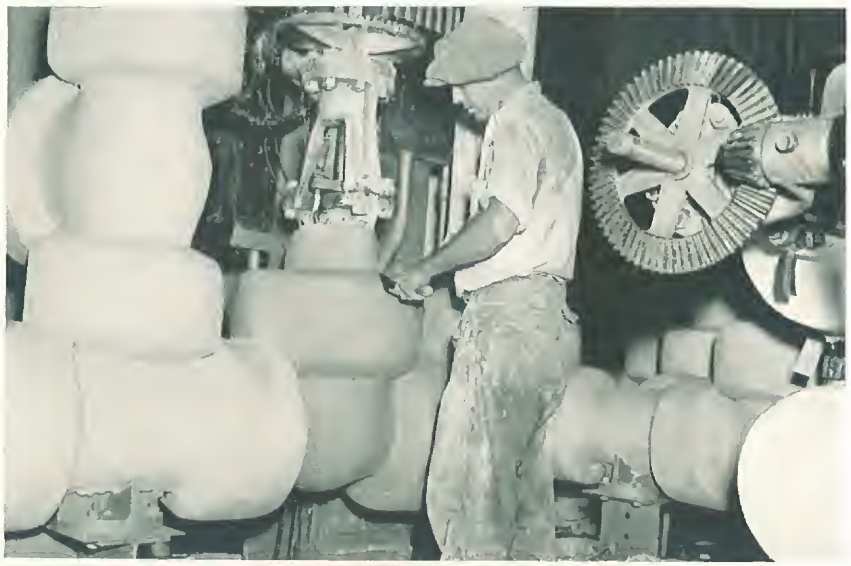
The drawing above illustrates the use of Ehret's Durocel Insulating Concrete on an existing regenerator wall. This application is but one of a multitude in which the great structural strength of a concrete-type insulation is required.

Ehret's Durocel Insulating Concrete can be readily mixed in the usual type of concrete mixing machine, or in the case of small quantities, it is readily prepared in a mortar box as shown at the left.

EHRET'S INSULATING CEMENTS

The insulating cements described on this data sheet are high in insulating efficiency, and they are easy to work and apply.

Where it is necessary for an application of insulating cement to be finished extra smooth and hard, the desired finishing cement (see Data Sheet No. 136) should be trowelled on over the surface of the dried insulating cement.



Pointing blocks on large fittings with Ehret's 85% Magnesia Cement

85% MAGNESIA CEMENT

For Temperatures up to 600° F.

Where the use of molded 85% Magnesia forms is not practicable, as on small fittings and valves and also on irregularly shaped surfaces, 85% Magnesia Cement provides a plastic insulation that has the high insulation efficiency and other desirable characteristics for which 85% Magnesia is noted. This cement is, of course, ideal for use in pointing up the crevices between 85% Magnesia blocks during their application.

Ehret's 85% Magnesia Cement comes in loose, dry form and needs only to be mixed with water to the proper consistency and then trowelled onto the surface that is to be covered. When applied in ¼-inch layers and permitted to dry between layer applications, it may be built up into considerable thicknesses without appreciable cracking or checking. Because of its great covering capacity, it is a very economical material to use. It is furnished in 60-pound bags and 75-pound barrels, and 100 pounds will cover approximately 66⅔ square feet, 1 inch thick.

ENDURO CEMENT

For Temperatures up to 2000° F.

Consisting of essentially the same material as that used in Ehret's Enduro blocks and pipe coverings, Ehret's Enduro Cement is used for purposes similar to those given for 85% Magnesia Cement. Enduro Cement comes in loose, dry form and, when mixed with water to form a plastic cement, its working characteristics are very much like those of 85% Magnesia Cement.

Ehret's Enduro Cement is widely used on temperatures above 600° F. because, like the molded forms of Enduro, it is efficient, economical and dependable. This material, when mixed to the proper consistency, will cover approximately 53 square feet, 1 inch thick per 100 pounds. It is packed in bags of 75 pounds each and barrels of 90 pounds each.

VALCULITE CEMENT

For Temperatures up to 1500° F.

Ehret's Valculite Cement is composed of a carefully proportioned mixture of expanded Vermiculite, asbestos fibres and a bonding agent. Since the materials of which it is composed are mainly inorganic, it is practically everlasting in service. Valculite has good adhesion characteristics, covers well, and finishes smooth. Conductivity is low, with subsequently high insulating efficiencies. When used on recommended temperatures, Valculite is fully reclaimable by merely breaking it up and mixing with water. However, the covering capacity of reclaimed Valculite is slightly lower than that of the new material.

In applying Valculite, the loose flakes need but to be mixed with water to the proper consistency and trowelled on. Proper application is made by trowelling on layers with sufficient time allowed for each successive layer to dry. The first layer should be applied ½" thick to the cleaned surface, and after drying, the successive layers may be applied 1" thick, until the desired thickness is obtained.

The covering capacity of Valculite Cement is high, being about 75 square feet, 1 inch thick (when wet), per 100 pounds of dry material. The drying of a 1-inch thick layer of wet Valculite will reduce its thickness to about .85 inch.

Valculite Cement is packed in strong corrugated paper cartons containing 25 and 50 pounds each.

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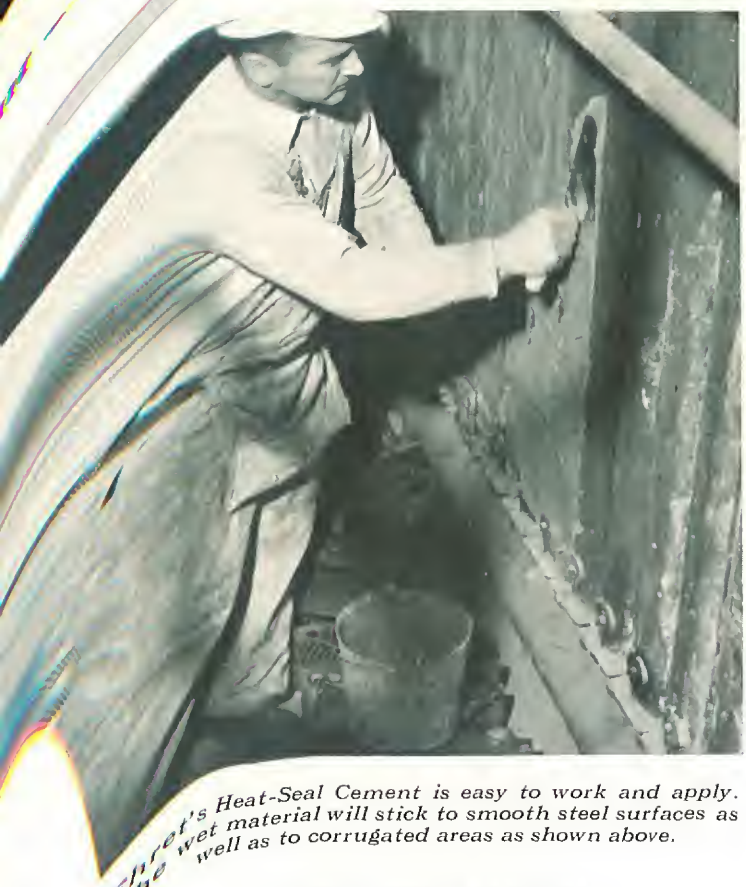


Ehret's Heat-Seal Cement is easy to work and apply. The wet material will stick to smooth steel surfaces as well as to corrugated areas as shown above.

HEAT-SEAL CEMENT

For Temperatures up to 1800° F.

As a plastic insulation, Ehret's Heat-Seal Cement is durable, permanent and possesses high thermal efficiency. Not only is its initial insulation value high but it remains efficient indefinitely even under severe conditions. Due to its great adhesive ability it clings stubbornly to smooth as well as rough surfaces, permitting it to be applied easily and rapidly by even unskilled workmen. It can be applied directly to hot as well as cold surfaces and to either brick or metal.

The most common use of Ehret's Heat-Seal Cement is for covering irregular shapes where it would be difficult to apply block type insulations. It is also useful for filling in and smoothing over spaces to provide a foundation for block insulations. It is very adaptable for insulating valves, fittings, etc., and is often preferable on account of the tenacity with which it fastens itself to the metal surfaces. When applied to large surfaces, such as tank-like equipment, it provides a very stable monolithic insulation. In most of which cases, however, it is advisable to use hexagonal mesh wire for reinforcement.

The principal ingredient of this cement is Ehret's Heat-Seal Insulating Wool, which consists of long, white mineral fibres that are blown by high pressure steam from molten material. These insulating wool fibres are thoroughly compounded with an accurately determined percentage of long asbestos fibres to provide greater strength. Heat resisting binding and bonding materials are then added to complete the mixture. The manufacturing processes are so perfectly controlled that the product is absolutely uniform and never varies from year to year.

The structural strength of Ehret's Heat-Seal Cement is extremely high and it will resist normal vibration, and the expansion and contraction of the surface on which it is applied, without loosening or disintegration. The outer surface of this cement will withstand considerable mechanical abuse, such as bumping, and although it might be dented or impressed, there is no shattering or breaking of the insulation layer.

In preparing for application, clean, fresh water should be added in the proportion of 2½ gallons of water to 10 pounds of cement. The mix should be thoroughly worked by shovel or hoe until all dry lumps are completely absorbed. It is important that the proper proportion of water be used, for, if too much water is added it might weaken the strength of the cement and cause difficulty in applying. For best results the first applications of the cement should be as small lumps spotted over the clean surface at approximately two inch spacings. When these have dried sufficiently to adhere firmly, the space between the lumps can be filled in and again left to dry. Additional layers of the cement can then be applied until the required total thickness is attained, each being permitted to dry before the next is applied.

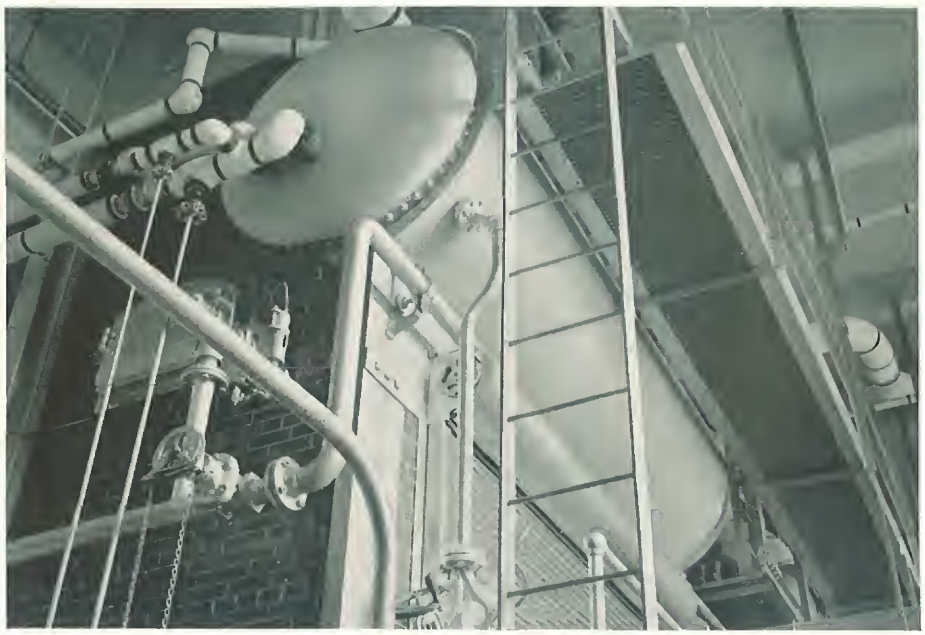
Where extra smoothness of the outer surface is desired, a coating of Ehret's No. 150 Asbestos Cement, ¼" to ½" thick, may be firmly troweled on. If an extremely hard surface is desired, the asbestos cement can be mixed with portland cement, ⅓ to ½ by weight.

For ordinary moisture or weather protection, to the outer surfaces a finishing coat of Ehret's Fibrekote, ¼" thick, should be applied. If specially secure protection is desired, the Fibrekote should be applied in two layers, each ¼" thick.

Ehret's Heat-Seal Insulating Cement will cover approximately 50 square feet to a thickness of 1 inch per 100 lbs. of cement. It can be applied either by hand or by trowel and for inaccessible locations it can be thrown against the surfaces to be covered where it will stick tightly. It is 100% reclaimable on surfaces where temperatures range up to 1200 degrees F., as it can be chipped from the surfaces, mixed with water and re-applied. It can, however, be used satisfactorily on surfaces whose temperatures are as great as 1800° F.

Ehret's Heat-Seal Insulating Cement is packed in bags of 50 lbs. net weight each. It can be kept in storage indefinitely without deterioration.

This boiler drum is insulated with 85% Magnesia blocks and finished with Ehret's No. 150 Asbestos Cement. Note neat manner of leaving drum-head rivets uncovered for inspection.



EHRET'S FINISHING CEMENTS

Although finishing cements have some insulating value, they should not be used primarily for insulating purposes. They are designed to be used as a protective layer over insulation blocks, coverings or insulating cements, and the range here listed will satisfy practically all needs.

All Ehret Finishing Cements contain asbestos fibres which act as a bonding agent. The types and quantities of fibre used is different, however, in the various kinds of cement.

Ehret Finishing Cements are all packed and shipped in loose, dry form. Packaging data, covering capacities and other information on these cements is given in the table on the reverse of this sheet. (Note—Cost per pound of these cements should not be considered as a true guide to their applied cost, because the lower cost cements have smaller covering capacities.)

P-K WHITE CEMENT

For Temperatures up to 1000° F.

This high quality prepared asbestos cement can be used as a roughing cement as well as a finishing cement. It dries smooth, hard and extremely white and has more insulating efficiency than any of the other finishing cements.

No. 105 CEMENT

For Temperatures up to 1500° F.

This cement is generally used as a final protective coating over insulating blocks or other cement. It has a smooth, glossy, hard finish, which can be painted with either cold water or lead and oil paint without the necessity of first applying a canvas jacket. It is usually applied in one-quarter-inch-thick layers.

No. 119 CEMENT

For Temperatures up to 1600° F.

Where a plastic cement must be used at semi-refractory temperatures, this cement has given most reliable service.

No. 150 CEMENT

For Temperatures up to 1000° F.

This is an insulating cement of very high quality, effective for both roughing in and finishing. It gives a hard, durable and attractive surface, which will not break or peel off. It is used in place of No. 200 where a better surface is required, as it will shrink and crack less than No. 200.

No. 175 CEMENT

For Temperatures up to 1200° F.

This is a semi-refractory product. It is an excellent combination insulating and refractory cement. Ideal for use as a protective coating over insulation, linings, breechings, flues, etc., exposed to erosive action of moving gases.

No. 200 CEMENT

For Temperatures up to 1000° F.

This is a commonly used type of Asbestos Cement. It is usually applied over molded insulation, but can be used by itself as an insulation on small boilers, etc., particularly by the Plumbing and Steamfitting trades. This is the best of the cheaper finishing cements.

No. 219 CEMENT

For Temperatures up to 1000° F.

This grade is often used in place of No. 200 where a cheaper grade is desired. It is economical to use but the covering capacity is not as good as that of No. 200. However, it contains sufficient binding material in the form of asbestos fibres to assure its adhesiveness.

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INSULATING AND FINISHING CEMENTS

Name of Cement	Type	Temperature Limit	Covering Capacity 1" thick per 100 lbs.	Packaging	Uses
85% Magnesia.	Magnesia.....	600° F.	66⅔ sq. ft.	{60-lb. bags... 75-lb. barrels.}	Insulating
Enduro.....	Diatomaceous.....	2000° F.	53 sq. ft.	{75-lb. bags... 90-lb. barrels.}	Insulating
Heat-Seal	Mineral Wool.....	1800° F.	50 sq. ft.	50-lb. bags....	Insulating
Valculite.....	Expanded Mica....	1500° F.	75 sq. ft.	{25-lb. cartons 50-lb. cartons}	Insulating
No. 105.....	Prepared Asbestos.	1500° F.	25 sq. ft.	100-lb. bags...	Hard Finish
No. 119.....	Prepared Asbestos.	1600° F.	15 sq. ft.	50-lb. bags...	Protective Cement
No. 150.....	Prepared Asbestos.	1000° F.	25 sq. ft.	100-lb. bags...	Hard Finish
No. 175.....	Prepared Asbestos.	1200° F.	18 sq. ft.	100-lb. bags...	Protective Coating
No. 200.....	Mine Run Asbestos	1000° F.	19 sq. ft.	100-lb. bags...	Smooth Finish
No. 219.....	Mine Run Asbestos	1000° F.	17 sq. ft.	100-lb. bags...	Smooth Finish
P. K. Cement..	Prepared Asbestos.	1000° F.	30 sq. ft.	100-lb. bags...	Smooth Finish

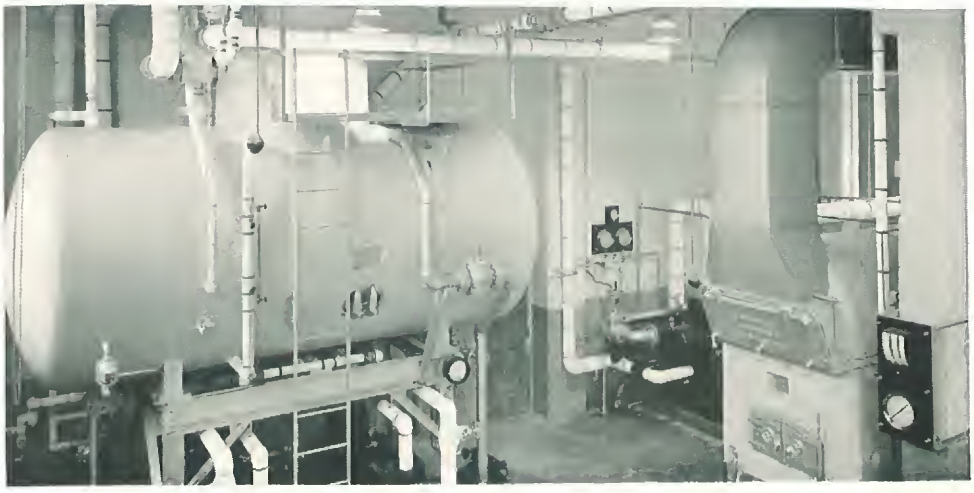
Approximate Amounts of Cement Required . . .

. . . to cover standard screw fittings to a thickness of 1 inch. For flanged fittings, add the required number of flange units.

Figures are in *Pounds per Fitting*, based on a cement with a covering capacity of 25 square feet, 1 inch thick, per hundred pounds. For cements of other covering capacities, use the factor table at the right.

Size of Fittings in inches	Cement Required, in pounds				
	Regular Ells	Tees and long radius Ells	Crosses	Valves	Flanges (one pair)
¾, 1.....	1.4	1.9	2.0	2.1	2.9
1¼, 1½, 2.	2.3	2.8	3.2	2.5	4.2
2½, 3.....	4.0	5.0	5.3	4.3	6.0
3½, 4.....	6.0	8.3	8.4	6.5	9.0

Multiplying Factors for Cements of Different Covering Capacities	
Covering Capacity	Multiply By—
15	1.7
17	1.5
18	1.4
19	1.3
30	.83
50	.50
53	.47
66⅔	.37
75	.33



Ehret insulations and finishing cements were used on the feedwater heater and high pressure boiler shown here. Note the neat covering of small pipe fittings, consisting of Ehret's No. 150 Asbestos Cement trowelled on over the 85% Magnesia insulating cement.

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COLD INSULATIONS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

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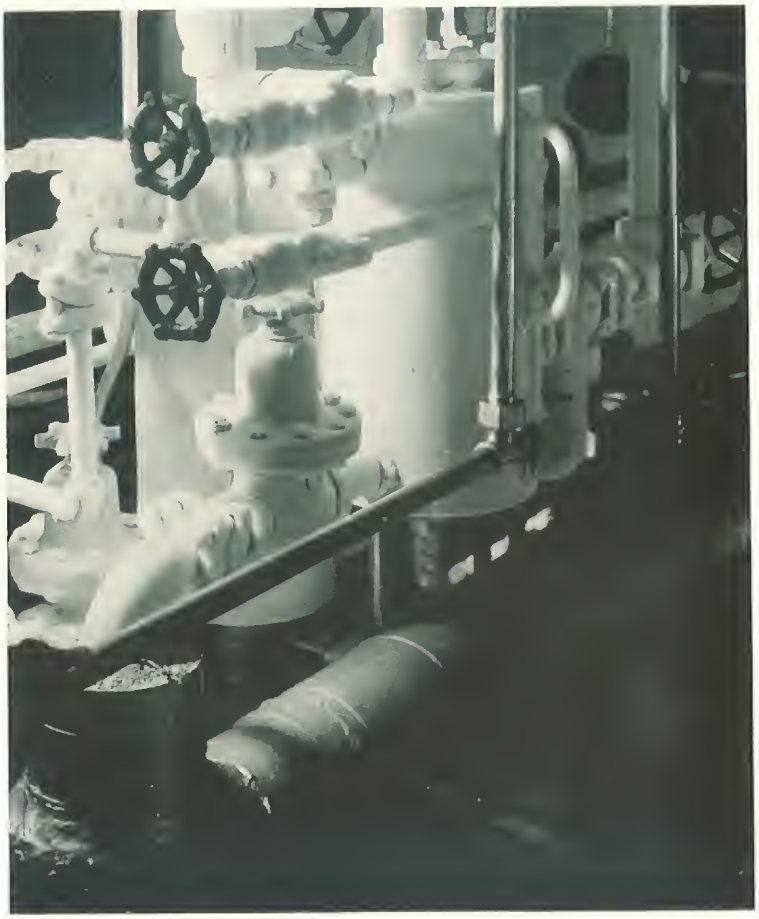

COLD INSULATIONS

During recent years the use of cold and refrigerated equipment has spread to many new fields. Most industries now depend on sub-normal temperatures for one or more steps in their storage, manufacturing or processing operations. The cooling and air-conditioning of homes, office buildings, factories, schools and public buildings forms a large and rapidly-growing branch of the low temperature industry. The mechanical refrigeration unit is fast becoming as well known and almost as widely used as that universal power and heating unit, the boiler.

Refrigerated and cold surfaces are insulated for fundamentally the same reason as heated surfaces —namely, to retard undesirable heat flow. Heat insulations save heat and prevent room temperatures from being raised to uncomfortable or dangerous levels. Cold insulations protect against waste of the power used for refrigeration and ensure the maintenance of desired subnormal temperatures.

In addition to being used to save power, cold insulations are used on exposed cold water tanks and pipes to guard against freezing in the winter and also to prevent condensation of atmospheric moisture in warm or humid weather. This latter condition is called "sweating" and it is responsible for untold damage to the walls and ceilings of buildings as well as to goods stored beneath un-insulated cold pipes in stockrooms and warehouses.

There are several points in the economics of cold insulations that merit special emphasis. The amount of power required to *lower* the temperature of a substance one degree by means of refrigeration ranges up to ten times the amount of power required to *raise* the temperature of the same substance one degree. Consequently, the relatively small temperature differentials in the field of refrigeration are very important from the standpoint of power savings through the use of adequate insulation.

In addition to the savings of power that result from properly insulating pipe lines and equipment, there are the problems of ensuring against food spoilage in refrigerated rooms and the dependable maintenance of sub-normal temperatures in many industrial processes. When low temperatures must be dependably maintained with accuracy, well chosen and properly applied cold insulations are an economic necessity.

Choice of Materials

There is a variety of time tested materials available to those who are faced with the problems of insulating cold surfaces. As in the field of heat insulations, there is no one material that is best suited to all conditions.

Before any material is chosen for an operating

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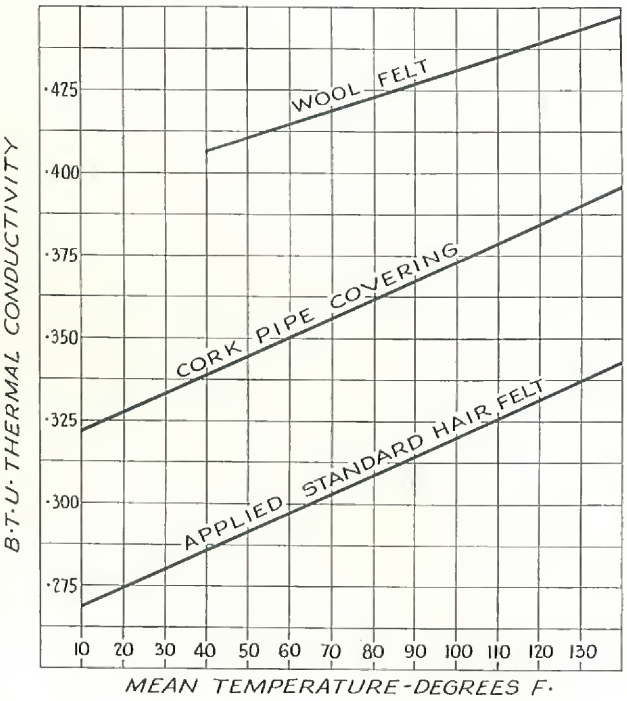
condition all available physical and economic factors should be given careful consideration. It is important that the materials chosen be of the proper type and of good quality. In the cold insulation field, the method of application is of particular importance because of the necessity of excluding air from the insulating material.

In heat insulation applications the entrance of airborne moisture presents no hazards, because the heat in the insulation itself tends to drive the moisture out. But in the insulation of low-temperature surfaces, air must be excluded or moisture will condense within the insulating material. Even small air leaks need to be guarded against because, once inside the insulation, the moisture is not driven off. A great amount of moisture can accumulate over a period of time under such conditions and a great loss of insulating efficiency is to be expected.

Where temperatures in refrigerated pipes or equipment are below freezing, the frost and ice that would be formed by the condensation of atmospheric moisture within the insulation is almost sure to ruin the application and possibly the insulating material itself. To guard against the possibility of air infiltration into any low temperature insulation, a dependable means of excluding air should be used, and the application should be made only by those who are skilled in the work.

The accompanying graph gives the thermal conductivity, at various mean temperatures, of the more important cold insulating materials. The final choice of an insulating material, however, should be made only after full consideration of the requirements and factors involved. The Ehret Company will be pleased to assist in choosing that material and method of application best suited to particular needs.



TYPICAL SAVINGS CALCULATIONS FOR COLD INSULATIONS

The following examples will serve to show how cold insulations effect major operating economies. Ehret engineers are available to assist in analyzing individual insulation problems and will furnish solution recommendations when desired.

EXAMPLE A:—A 100-foot length of 4″ refrigerating piping is insulated with Ehret's Special Thick Brine Cork Pipe Covering. What saving per year does this insulation effect if the refrigerant is at a temperature of minus 20 degrees F. and the room is at 70 degrees F.

SOLUTION:—By referring to the table of Bare Pipe Losses (Sheet No. CI 209) it is noted that the loss per lineal foot per degree F. of temperature difference is 58. BTUs every 24 hours. The chart showing heat losses through Cork Pipe Coverings gives the unit loss through the insulation as 4.35 BTUs every 24 hours. The difference of 53.65 BTUs is the unit saving every 24 hours. Multiplying by the length of the pipe (100 feet), again by the temperature difference between pipe and air in the room (90° F.) and then by 365 days gives a total of 176,240,250 BTUs. Dividing by 288,000 (the BTUs per ton of refrigeration) results in 611.9 tons of refrigeration saved per year. At a refrigeration cost of $1.50 per ton this would be a monetary saving of $917.85 per year.

EXAMPLE B:—What is the saving effected, per 100 square feet of wall area per year, by an insulation consisting of a 4-inch thickness of Ehret's Corkboard on a hollow clay tile wall of 12-inch thickness. The storage room temperature is 20° F. and the outside air is at 70° F.

SOLUTION:—By referring to the table of Heat Transmission through Structures (Sheet No. CI 212) it is seen that .31 BTU is the heat transmission through uninsulated 12″ hollow clay tile. It is also noted that the unit heat transfer through this wall structure when insulated with 4 inches of Ehret's Corkboard is .057 BTU on the same unit basis. The difference of .253 BTU is the saving in heat units. Multiplying by the temperature difference (50° F.) and again by the number of hours in a year (8760) gives 110,814 as the total BTUs saved per year per square foot of wall surface. For 100 square feet this would be 11,081,400 BTUs. Dividing by 288,000 (the BTUs in one ton of refrigeration) gives 38.5 tons of refrigeration saved. At a cost of $1.50 per ton this totals $57.75 which represents the monetary saving per year per 100 square feet of wall area.

EHRET'S HAIR FELTS . . .

Nature provides hair to protect animals against temperature differentials. Hair has been used by man for untold centuries, in the form of robes and clothing as a "personal" insulating material. And for many years, products made of certain types of hair have been used with great success as building and industrial low temperature insulations.

Of the many types of hair that have been used in the manufacture of cold insulating materials, cattle hair has proven to be the most satisfactory from the dual standpoint of insulating efficiency and economy. Ehret's Hair Felt products are made from the highest quality cattle hair which, in some cases, is used 100% pure, and in others it is combined with materials such as jute, goat hair and asbestos fibres in accordance with the various product specifications.

Unless hair is properly cleaned and treated, it is likely to lose much of its life expectancy. The machining and processing methods by which the hair is fabricated into finished insulating products is as important as the quality of raw materials used. The methods used in the manufacture of Ehret's Hair Felt products are such as to ensure high insulating efficiency, long life and good workability characteristics.

In the process of making Ehret's Hair Felt, the hair is washed, opened and spread out, and then subjected to air cleaning and picking which removes all short hairs, dust, dirt and foreign matter. The cleaned and graded hair is then ready for fabrication into the various types of felt.

Hair felts are made in two ways, namely, by the platen or laid process and the punching or loom process. The felts made by these two processes of manufacture have certain characteristic differences. In the platen process the hairs are felted by steam pressure and vibration into a closely intertwined mass that is light in weight, yet has sufficient tensile strength to maintain its shape under service conditions. Felts made by the punch process are subjected to a multiple piercing with tiny needle-like steel wires that pull hairs through the felt to unify the felt structure. One type of punched felt is made with a core of burlap through which the hairs of the felt are punched, and another type is bonded with punchings of jute fibres.

Hair felts are widely used as cold insulations on pipes and equipment where temperatures range down to the lowest sub-zero. They are also used for sound deadening purposes as described on Ehret Data Sheets devoted to Building Insulations and Materials. The several types of hair felt insulations vary in insulating efficiency, physical characterisitcs, size and form. Each type of felt is made in various thicknesses, and service recommendations are given under the descriptions of the various types of material.

The fact that hair felt is applied in layers permits it to be installed in various ways. Joints in layers can be staggered and moisture proof membranes can be inserted to prevent the entrance of atmospheric moisture. Pipes, fittings, tanks, walls and practically all odd-shaped surfaces can be smoothly, efficiently and readily insulated with hair felt. Special tools or equipment are not required for cutting or fitting, and once properly installed, hair felt will provide lasting, highly efficient and thoroughly satisfactory low temperature insulation.

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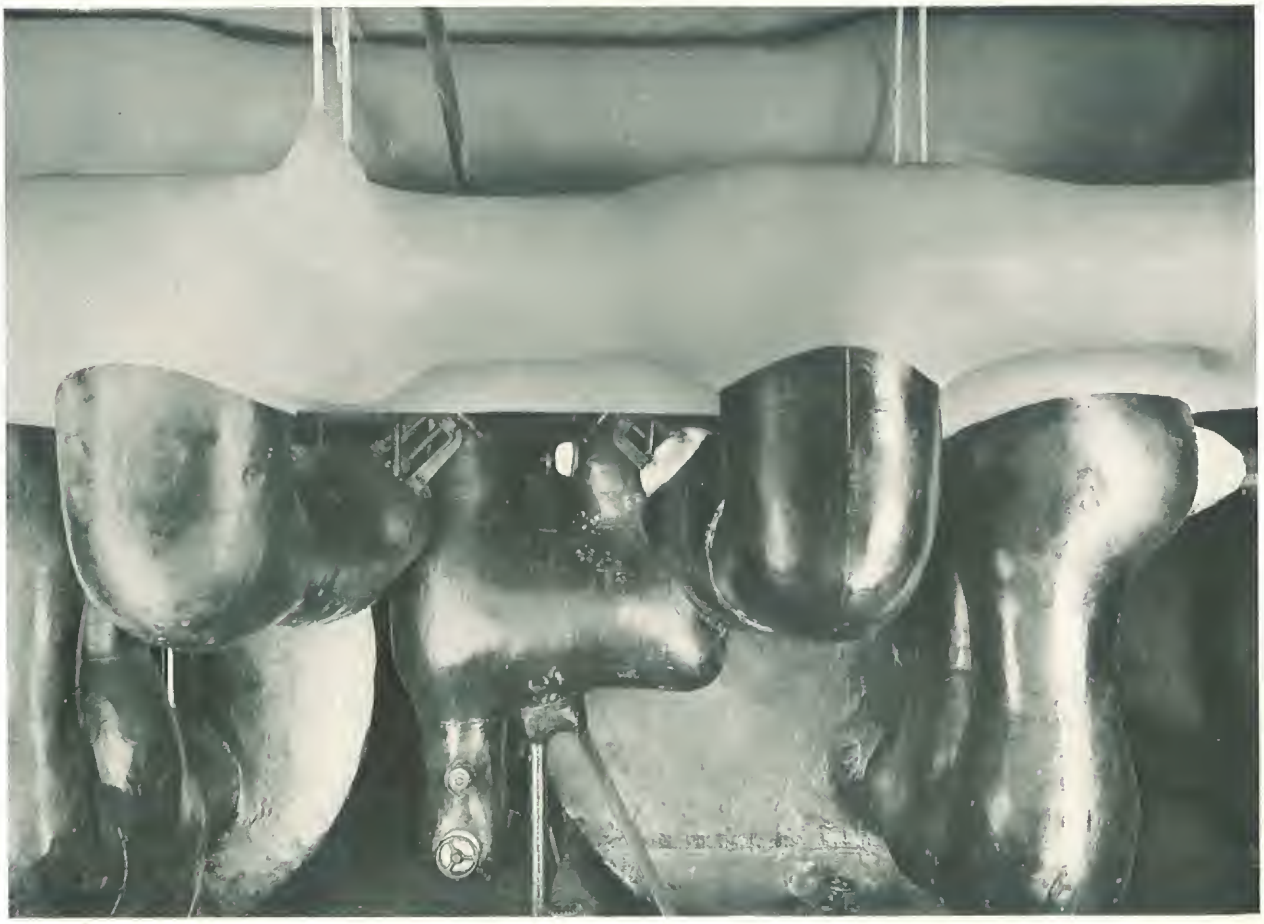
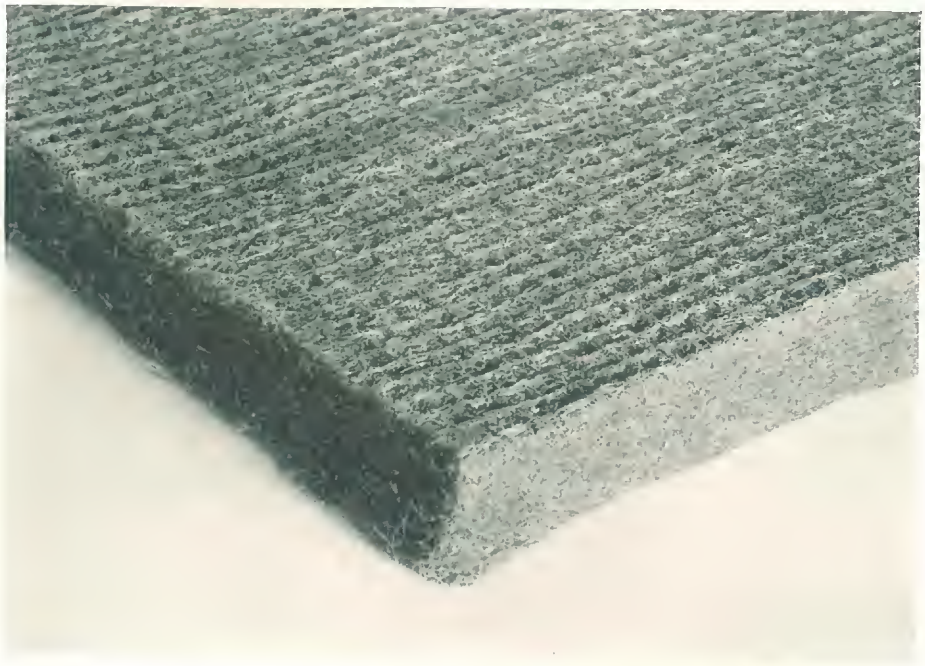
EHRET'S STANDARD HAIR FELT . . . was used in insulating the refrigeration lines and tanks shown in these two illustrations. Three 1″ layers were applied and the smooth outer finish consists of painted canvas jackets. Note how the insulation has been extended up the supporting rods to reduce heat conduction.





EHRET'S STANDARD HAIR FELT

Consisting of 100% pure brown cattle hair, Ehret's Standard Hair Felt is widely used on cold and refrigerated piping and equipment whose temperatures range down to the lowest sub-zero. The extremely high insulating efficiency of Standard Hair Felt is not subject to loss by settling, packing or disintegration. When properly applied on recommended services it can be depended upon for highly efficient, trouble-free, permanent protection.

The services for which Ehret's Standard Hair Felt is used include practically all types and sizes of cold water and refrigerated piping and equipment. Its application flexibility permits snug air-tight fitting of all joints, even on irregular and odd-shaped surfaces. All Ehret's Standard Hair Felt is made by the platen process and it is easily distinguishable from other types by the waffle-like pattern on one side. It is odorless and vermin proof and when moisture is excluded it will maintain its insulation efficiency indefinitely.

Sizes and Thicknesses

Always furnished in rolls, Ehret's Standard Hair Felt is available in sizes as follows:

3 feet x 50 feet
3 feet x 100 feet
6 feet x 50 feet
9 feet x 50 feet.

Odd sizes will be furnished on request, at a nominal cutting charge. Complete 9 ft. x 50 ft. rolls, however, will be cut longitudinally into 2 or 3 pieces at no cutting charge.

Available thicknesses and weights of Ehret's Standard Hair Felt are as follows:

Thicknesses	APPROXIMATE WEIGHTS	
	Per Square Ft.	Per 300 Sq. Ft. Roll
¼"	4 oz.	75 lbs.
½"	6¼ oz.	120 lbs.
¾"	8½ oz.	160 lbs.
1"	11 oz.	210 lbs.
1¼"	13½ oz.	255 lbs.
1½"	16 oz.	300 lbs.
2"	21 oz.	395 lbs.

Application Recommendations

For full economy it is highly important to use the proper thickness of hair felt. Individual conditions and requirements vary widely, but the accompanying table of recommended thicknesses will serve as a guide.

It should be noted, however, that because of the high cost of producing subnormal temperatures the thickness of insulation should always be ample.

Temperature range in Degrees F.	Number and Thickness of Layers
15 to 50	2 layers of 1" material
zero to 15	3 layers of 1" material
–20 to zero	4 layers of 1" material
–40 to –20	5 layers of 1" material
–60 to –40	4 layers of 1" material and 1 of 2"
–80 to –60	4 layers of 1" material and 2 of 2"
–100 to –80	4 layers of 1" material and 3 of 2"
–120 to –100	4 layers of 1" material and 4 of 2"

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There are two general methods for applying hair insulation. For service conditions that are not severe the Built-Up Method is quite satisfactory, where it is necessary to obtain maximum protection the Air-Sealed Method justifies its slight additional cost by its dependability under even the most extreme operating and service demands. In both methods the following details apply:

The metal surfaces that are to be covered should be made clean and absolutely dry. A layer of tar paper should be smoothly applied to the prepared surfaces and secured by wrappings of jute twine. The consecutive layers of hair felt should be so placed that both end and side seams are staggered. All joints should be snug and tight with no overlapping and no buckling.

Built-Up Method

In the Built-Up Method a layer of tar paper should be wrapped over the outer surface of each layer of hair felt, and secured by wrappings of heavy jute twine at 1″ spacings. The layer of tar paper that is applied over the outer layer of hair felt should be secured with separate loops of No. 16 gauge Copperweld wire at 4″ spacings. The ends of all wire loops should be firmly twisted together with pliers, bent over and carefully pressed against the surface of the tar paper to avoid projections. All tar paper layers are to have 3″ laps at all edges.

Air-Sealed Method

When the Air-Sealed Method is to be used the tar paper around each layer of hair felt is omitted. As each layer of hair felt is applied, it should be secured by wrappings of heavy jute twine at 1″ spacings and the surface of each layer should be either heavily coated with a waterproof sealing compound or spirally wrapped with a self-sealing tape with over-lapped edges.

Flanges, Valves and Fittings

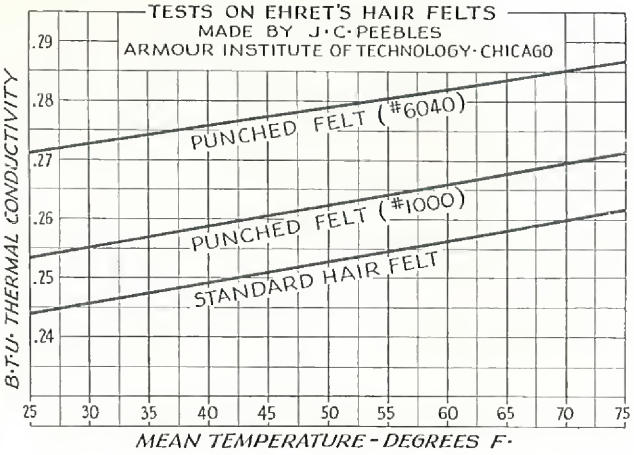
In both of the above methods of hair felt application the insulation on flanges, valves and fittings should be of the same material and thickness as that on the adjacent piping. The pipe insulation adjacent to flanges should be stopped off at a sufficient distance to permit the removal of flange bolts. The ends of the pipe insulation should be tapered and tightly bound with close wrappings of twine, and then thoroughly coated and sealed to the pipe with a waterproof sealing compound.

When covering the flanges, all layers should be firmly held in place by close wrappings of strong jute twine applied in a criss-cross manner. The inner layers of the hair felt should be tucked down closely over the sides of the flange. The top layer of hair felt should be cut long enough to permit overlapping the adjacent pipe covering for a distance of 3″ beyond the taper, and it should be wrapped and sealed onto the pipe covering with a heavy coat of a waterproof sealing compound.

Finishes

Where sewed jackets are desired, 8-ounce enamelling duck should be drawn tightly and smoothly over a wrapping of 40-lb. rosin sized paper. All seams should be located where least visible and neatly and securely sewed with cotton twine.

The outside finish on valves and fittings should be the same as that on the adjacent pipe coverings. Sewed jackets on pipe coverings, may be extended to include the valves and fittings.



EHRET'S PUNCHED HAIR FELTS

Ehret's Punched Hair Felts are made by the needle or loom process, and although they are efficient insulating materials, their use as thermal insulations is generally limited to ice water and cold water piping and equipment, and to prevent freezing on exposed locations.

The two types of Ehret's Punched Hair Felts here listed will answer practically all normal requirements for this material. They are available in the same thicknesses and sizes as those given for Ehret's Standard Hair Felt.

Ehret's Punched Felt No. 1000 is the best of the punched felts. It is made from pure brown cattle hair that is prepared in the same manner as that used in the manufacture of Standard Hair Felt. There are two styles of No. 1000 Punched Felt, namely, style 1000 BC in which the hairs are punched through a centrally located burlap core, and style 1000 NBC which does not have the burlap core. The felt with the burlap core is mechanically stronger than the no-burlap type.

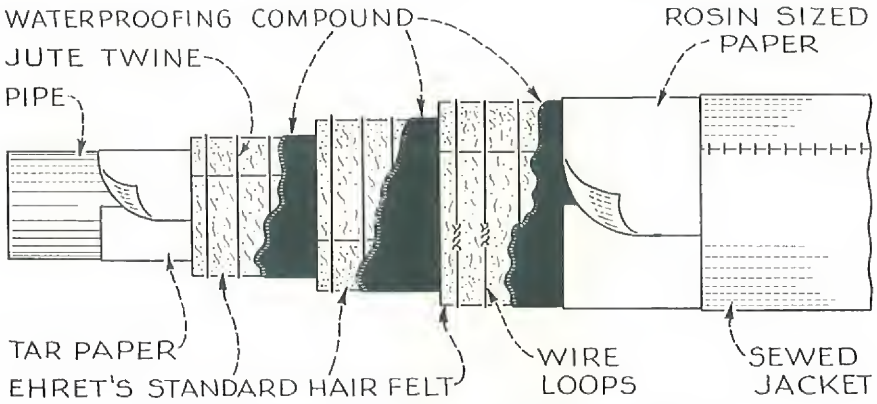
Ehret's Punched Felt No. 6040 is the lowest in cost and the lowest in thermal efficiency of all the Ehret's Hair Felts. It is made of cattle hair and long jute fibres that are punched throughout to bind the mass. Its use is recommended only where low initial cost is of primary interest.

Ehret's Standard Hair Felt

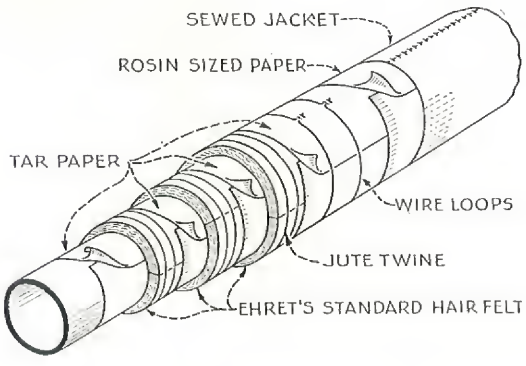
Heat Transmissions (approx.) of applied insulation in BTUs per Hour per Degree F. temperature difference between pipe and air. (Based on normal refrigerating temperatures.)

Pipe Size Inches	1-inch thick		2-inch thick		3-inch thick		4-inch thick		5-inch thick		6-inch thick	
	Per lineal foot	Per sq. foot of pipe	Per lineal foot	Per sq. foot of pipe	Per lineal foot	Per sq. foot of pipe	Per lineal foot	Per sq. foot of pipe	Per lineal foot	Per sq. foot of pipe	Per lineal foot	Per sq. foot of pipe
½	.109	.497	.077	.351	.065	.298	.058	.265	.....	.....	.....	.....
¾	.122	.445	.083	.310	.071	.259	.063	.230	.....	.....	.....	.....
1	.145	.421	.094	.275	.075	.218	.070	.204	.064	.187	.058	.170
1¼	.175	.395	.112	.256	.092	.211	.081	.186	.071	.163	.064	.148
1½	.183	.368	.118	.238	.088	.196	.082	.167	.075	.152	.069	.138
2	.219	.351	.128	.206	.108	.174	.090	.144	.083	.134	.077	.124
2½	.254	.337	.151	.200	.119	.159	.099	.131	.094	.125	.085	.113
3	.297	.325	.173	.189	.133	.145	.113	.123	.106	.116	.093	.102
3½	.324	.317	.189	.181	.147	.141	.120	.115	.112	.107	.099	.095
4	.364	.308	.205	.174	.155	.132	.129	.110	.118	.100	.108	.092
4½	.390	.298	.223	.170	.170	.130	.138	.106	.125	.096	.114	.087
5	.427	.293	.245	.168	.185	.127	.148	.102	.134	.092	.119	.082
6	.500	.287	.280	.161	.206	.119	.166	.096	.151	.087	.136	.078
7	.564	.282	.312	.156	.230	.115	.184	.092	.164	.082	.146	.073
8	.630	.278	.346	.153	.252	.111	.202	.089	.179	.079	.158	.070
9	.695	.275	.378	.149	.276	.109	.220	.087	.194	.077	.172	.068
10	.765	.272	.410	.147	.298	.106	.234	.084	.208	.074	.183	.065
12	.855	.269	.458	.144	.326	.103	.272	.081	.241	.072	.211	.063
14	1.130	.267	.605	.143	.422	.101	.330	.079	.293	.070	.255	.061
16	1.240	.265	.670	.142	.468	.099	.366	.078	.320	.068	.278	.059
Flat	.....	.253	.....	.126	.....	.084	.....	.063	.....	.051	.....	.042

TYPICAL DETAILS . . . of the application of Standard Hair Felt to cold and refrigerated piping. These application methods are also used on tanks, ducts and similar equipment.

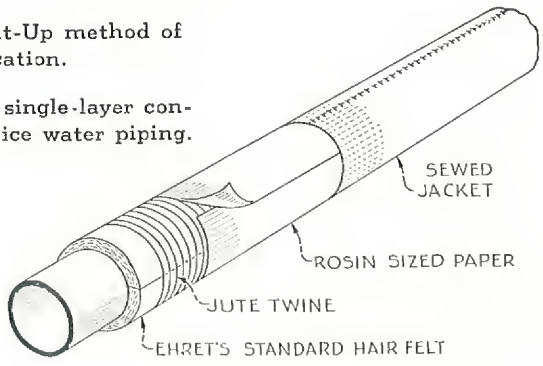


Air-Sealed Method of applying Standard Hair Felt



Left . . . Built-Up method of Hair Felt Application.

Right . . . single-layer construction on ice water piping.



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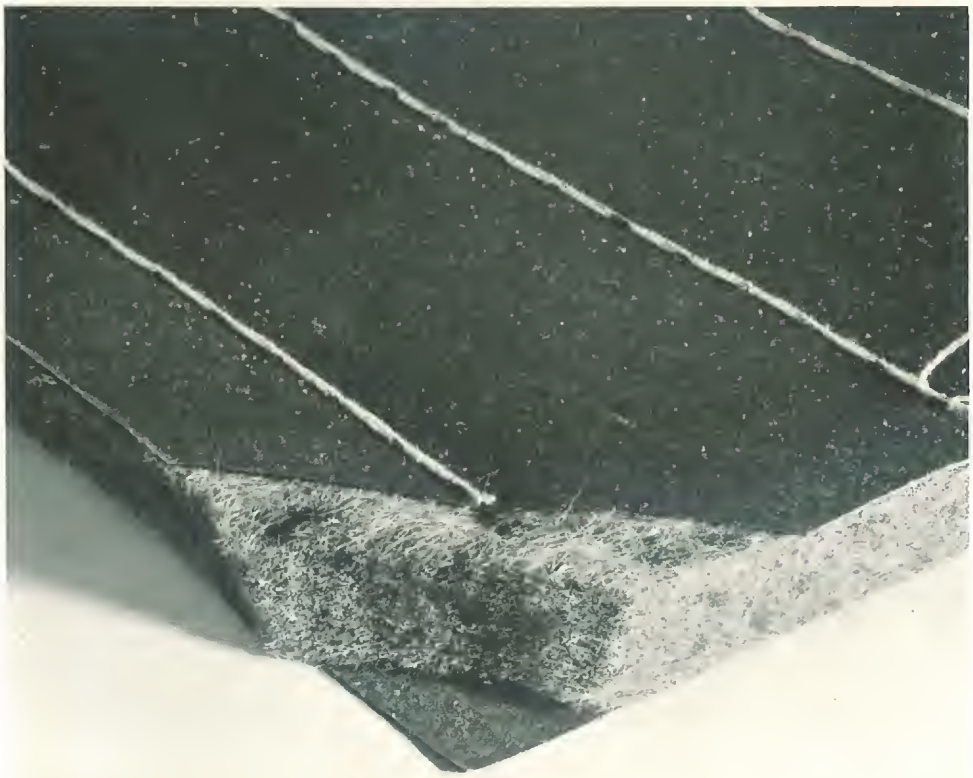
Standard Hair Felt to Prevent Freezing

a—Number of Hours to Cool to 32° F.
b—Pounds of Water Flowing per Hour per Lineal Foot to Prevent Cooling to 32° F.

Pipe Size	Thickness of Insulation	Air at Zero F.						Air at −10° F.						Air at −20° F.					
		Water 40°		Water 50°		Water 60°		Water 40°		Water 50°		Water 60°		Water 40°		Water 50°		Water 60°	
Inches	Inches	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
1	1	1.03	.665	1.54	.365	1.98	.280	.68	.821	1.27	.435	1.70	.324	.57	.980	1.10	.506	1.50	.374
	2	1.26	.442	2.31	.243	3.00	.185	1.02	.545	1.92	.288	2.55	.218	.86	.648	1.65	.338	2.26	.245
	3	1.59	.351	2.90	.191	3.68	.152	1.28	.432	2.35	.235	3.17	.175	1.05	.530	2.02	.273	2.80	.198
	4	1.81	.310	3.30	.167	4.30	.129	1.46	.380	2.76	.202	3.70	.149	1.23	.453	2.40	.235	3.26	.169
2	1	1.84	1.006	3.35	.550	4.42	.418	1.50	1.240	2.81	.652	3.80	.485	1.26	1.460	2.40	.755	3.30	.562
	2	3.13	.590	5.66	.328	7.40	.248	2.52	.735	4.75	.388	6.40	.290	2.10	.870	4.10	.450	5.60	.328
	3	3.90	.475	7.12	.265	9.05	.210	3.17	.582	5.80	.318	7.80	.237	2.60	.712	4.90	.348	6.80	.270
	4	4.50	.413	8.20	.225	10.75	.171	3.67	.505	6.90	.267	9.20	.200	3.10	.600	5.90	.306	8.10	.228
3	1	2.98	1.350	5.40	.740	7.05	.572	2.40	1.670	4.50	.890	6.10	.660	2.00	2.000	3.90	1.030	5.30	.757
	2	5.00	.805	9.05	.445	11.90	.340	4.00	1.000	7.60	.528	10.50	.386	3.40	1.190	6.80	.600	9.10	.442
	3	6.70	.602	12.10	.332	15.60	.260	5.40	.745	10.00	.403	13.20	.302	4.40	.905	8.50	.480	11.60	.345
	4	7.80	.520	14.10	.283	18.50	.218	6.30	.640	11.80	.338	16.00	.250	5.20	.762	10.20	.390	14.00	.287
4	1	4.05	1.670	7.3	.910	9.6	.700	3.2	2.080	6.1	1.090	8.1	.820	2.7	2.450	5.3	1.270	7.2	.930
	2	7.05	.955	12.7	.525	16.5	.408	5.6	1.180	10.5	.630	14.3	.465	4.7	1.420	9.2	.722	12.5	.530
	3	9.75	.560	17.4	.385	22.2	.303	7.7	.860	14.3	.470	19.1	.352	6.3	1.055	12.2	.545	16.7	.400
	4	11.10	.600	20.4	.328	26.8	.250	9.1	.730	17.0	.390	23.0	.290	7.6	.875	14.7	.450	20.2	.332
6	1	6.35	2.290	11.5	1.270	15.1	.970	5.1	2.870	9.6	1.515	13.0	1.120	4.2	3.400	8.3	1.750	11.5	1.290
	2	11.30	1.280	20.6	.711	26.8	.545	9.1	1.570	17.0	.852	23.2	.650	7.6	1.920	14.8	.975	20.5	.715
	3	16.00	.908	29.3	.500	37.3	.392	13.0	1.125	23.6	.611	32.0	.458	10.2	1.370	20.2	.710	28.0	.518
	4	19.00	.765	34.6	.425	45.5	.322	15.5	.945	29.0	.500	39.4	.372	13.0	1.125	25.1	.580	34.5	.422
8	1	8.78	2.870	15.8	1.560	20.6	1.200	7.0	3.540	13.2	1.890	17.5	1.390	5.9	4.200	11.5	2.170	15.5	1.585
	2	15.60	1.580	28.4	.878	36.8	.670	12.5	1.970	23.6	1.040	31.5	.770	10.5	2.330	20.7	1.210	27.7	.885
	3	22.50	1.110	41.0	.605	52.0	.470	18.1	1.360	33.0	.740	41.5	.556	14.7	1.670	29.0	.865	39.0	.630
	4	27.00	.925	49.2	.510	64.0	.387	22.0	1.135	41.0	.600	55.0	.445	18.2	1.350	36.5	.695	48.0	.515
10	1	11.20	3.480	20.2	1.930	28.8	1.480	9.0	4.280	16.7	2.270	25.0	1.680	7.5	5.100	14.5	2.630	21.7	1.920
	2	20.10	1.910	37.2	1.030	52.7	.800	16.5	2.320	31.0	1.240	45.0	.925	13.7	2.780	26.7	1.400	41.0	1.020
	3	29.60	1.290	53.5	.715	74.8	.562	24.0	1.610	44.0	.875	64.0	.650	19.5	1.970	38.0	1.020	54.0	.740
	4	35.60	1.085	64.5	.595	92.0	.460	28.7	1.335	53.7	.710	79.0	.530	24.0	1.580	46.5	.820	70.0	.600



EHRET'S INSUL-FELTS . . .

In a large number of low temperature insulation applications, there are advantages to be gained by the use of hair felt that is sewed between layers of paper. In addition to protection and greater structural strength, these paper membranes provide a moisture-proof seal that greatly reduces the likelihood of moisture or air infiltration.

Ehret's Insul-Felts will answer most needs for prefabricated hair felt insulation. In all types of Insul-Felt, the felt used is manufactured from 100% pure brown cattle hair by the platen process, and the difference lies in the kind of membranes used for backings.

In making Ehret's Insul-Felts, the backings are placed on both sides of the felt and then sewed together by stitches of twine that pass completely through the hair felt layer. Unless otherwise specified, 1" stitches will be used in rows that are at 4" spacings. Stitches up to 2" in length in rows spaced up to 6" will be furnished if desired.

Hair felt that is sewed between membranes has a density of approximately 12 oz. per sq. ft., 1" thick. The recommended thicknesses for Insul-Felt are identical with those given for Ehret's Standard Hair Felt. (See Data Sheet No. CI-203.)

Available Types

Three types of Ehret's Insul-Felt are available as follows:

TYPE KK INSUL-FELT. In this type of material, the hair felt has a heavy Kraft paper on both sides. It is an insulation that is well suited for use on storage tanks, coolers, chillers, accumulators, anhydrous ammonia tanks and similar equipment. The Kraft paper is tough, strong and practically moisture-proof.

In addition to being used to maintain low temperatures, this and the following type of Insul-Felt are frequently used to cover exposed oil and chemical tanks to prevent evaporation in hot weather and thickening or congealing in cold weather. In such cases, however, the Insul-Felt should always be protected by a suitable weather-proofing such as trowelled-on coats of Ehret's Fibrekote.

TYPE KT INSUL-FELT. The backings on this type of Insul-Felt consist of the heavy Kraft paper on one side and 85-lb. asphalt-saturated paper on the other. Its uses are similar to those given for Type KK, and this material is somewhat more moisture-proof so it is suitable for conditions requir-

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ing better moisture-resisting characteristics. When applying, the asphalt-saturated backing should be placed so as to keep moisture out of the felt.

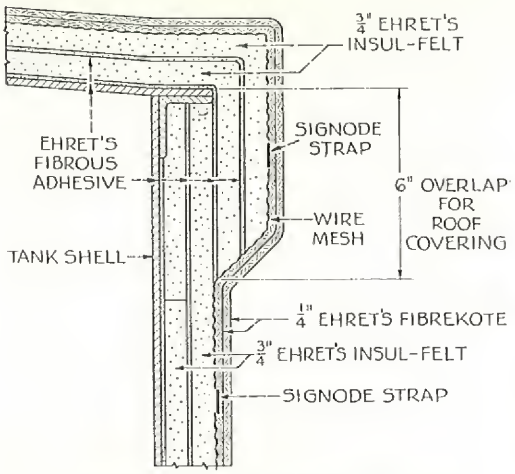
TYPE TT INSUL-FELT. With 85-lb. asphalt-saturated paper on both sides of the hair felt, this type of Insul-Felt is especially suitable for use in railroad refrigerator cars, tank cars, ice houses, ice cream units and domestic refrigerators. It is also widely used to insulate the many processing rooms and equipment in chemical and other industries that require accurate, dependable maintenance of subnormal temperatures. Because of its two asphalt-saturated membranes, this material is the most highly moisture-resistant of the Insul-Felts. On wet or weather-exposed applications, however, it should be water-proofed with Ehret's Fibrekote or a similar weather-proofing.

Sizes and Thicknesses

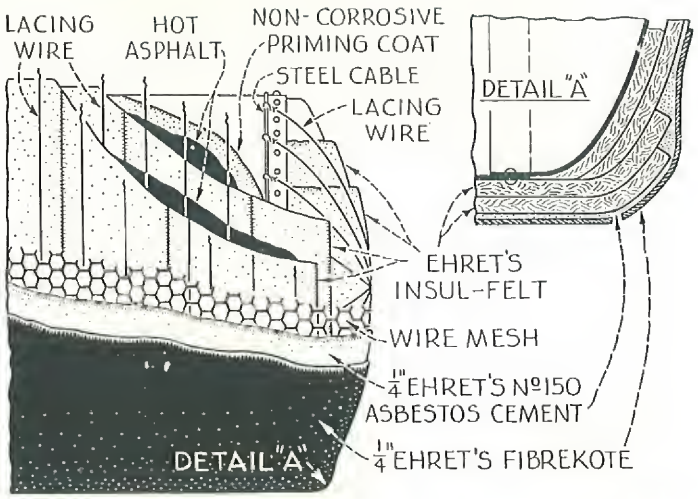
All three types of Ehret's Insul-Felt are available in roll form, as follows:

Sizes—9 feet wide by 30 feet long
9 feet wide by 60 feet long

Thicknesses in inches	Weight per square ft. in ounces	TOTAL LBS. PER ROLL	
		9 ft. x 30 ft.	9 ft. x 60 ft.
½	7	118	236
¾	9½	152	304
1	12	203	405
1¼	14½	245	489
1½	17	287	574
1¾	19½	329	658
2	22	372	743



INSULATION OF VERTICAL TANKS TO PREVENT EVAPORATION



ANHYDROUS AMMONIA TANKS–INSULATION DETAIL

Ehret's Insul-Felt is widely used on oil storage tanks to prevent evaporation or congealing of tank contents

EHRET'S WOOL FELT PIPE COVERINGS

Ehret's Wool Felt Pipe Coverings are designed primarily for use on cold water service piping. These coverings are made of laminated wool felt and the material used in their manufacture is thoroughly dried and tested before being built up into covering form.

STANDARD WOOL FELT COVERINGS

The wool felt used in Ehret's Standard Wool Felt Pipe Coverings is put through a special process that imparts a wave-like structure to the felt. The final built-up pipe covering is consequently lighter and has a lower conductivity than that made from flat felt. Both weight and conductivity are decreased approximately 30% with practically no reduction of structural strength.

Ehret's Standard Wool Felt Coverings have integral liners that protect the wool felt from the pipe. The following three types of liners are available:

Universal liner—is widely used because it is suitable for service on either hot or cold pipes. It is made of a heavy asphalt-saturated asbestos paper that is built into the covering itself. The Universal liner is the most commonly used because, in addition to its being perfectly satisfactory for use on both services, it obviates the necessity of carrying more than one type of wool felt covering in stock. Unless otherwise requested, Ehret's Standard Wool Felt Pipe Coverings will be furnished with the Universal liner.

Cold Water liner—consists of a heavy asphalt-saturated paper, and coverings with this liner should not be used on hot water services, but only on cold water lines.

Hot Water liner—consists of a strong asbestos paper that permits the use of the covering on water lines that carry temperatures up to 212° F.

Standard Wool Felt Pipe Coverings are furnished in 3 ft. sections and are made to accurately fit standard steel and wrought iron pipe sizes from ⅜" up. They are also available for standard sizes of copper pipe or tubing. Wool felt coverings are supplied in the following thicknesses: ½" and ¾" (in single layer construction), 1", 1½" and 2" (in either single layer or double layer construction). Where utmost efficiency is desired, double layer coverings should be used, as the staggering of the horizontal and longitudinal joints reduces the infiltration of air and thereby increases insulation efficiency. Coverings are furnished with regulation canvas jackets and sufficient gold lacquered bands for application. The sections are neatly packed in labeled cartons in which the bands are included.

EHRET'S STANDARD WOOL FELT PIPE COVERINGS

Heat Transmission, in BTUs per Square Foot of pipe surface per Hour per Degree F. temperature difference between pipe and air. (Based on 50° temp. difference).

Pipe Size Inches	Thickness of Covering in Inches			
	½	¾	1	1½
½	.929	.808	.728	.615
¾	.858	.738	.657	.555
1	.803	.680	.600	.500
1¼	.751	.628	.550	.452
1½	.726	.602	.524	.430
2	.691	.568	.492	.396
2½	.657	.544	.466	.372
3	.646	.522	.445	.352
3½	.635	.508	.432	.340
4	.624	.500	.424	.332
4½	.614	.481	.406	.325
5	.604	.476	.402	.312
6	.600	.468	.394	.301

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ALUMINO WOOL FELT COVERINGS

This type of Wool Felt Pipe Covering is a very attractive, factory-finished product. It is made of the same type of wave-structure felt and constructed in the same general manner as Standard Wool Felt Covering. Alumino Wool Felt Coverings are finished on the outside with a specially prepared crinkled asbestos felt which has been given a heavy coating of aluminum paint. This outside layer prevents shrinkage and the painted surface gives a rich decorative finish. In addition to being highly fire-resistant, these coverings are proof against moisture, moths and vermin. Furnished only with universal liner for application to either cold or hot water piping.

Alumino Wool Felt Coverings come ready for installation, and no finish is necessary on the job. They can be applied quickly and do not require the use of paste. Since their use eliminates the necessity for painting and their application requires so little effort, the applied cost of these coverings compares very favorably with that of Standard Wool Felt. For use in exposed places such as walking tunnels and basement recreation rooms, these highly finished coverings are well suited. They are furnished in the same sizes as Standard Wool Felt Coverings, and cartons include extra-width black lacquered bands.

SOLID WOOL FELT COVERING

Certain Government specifications require the furnishing of a Wool Felt Pipe Covering which is made from flat wool felt paper instead of the wave-like material layers. This type of covering can be furnished on special order with any of the three types of liners described under Standard Wool Felt, in regulation pipe sizes and finished with canvas jacket and bands. Instead of being packed in cartons, however, Ehret's Solid Wool Felt Pipe Covering is generally shipped in crates.

PACKAGING TABLE

Ehret's Wool Felt Pipe Coverings

Pipe Size	Standard Wool Felt						Alumino Wool Felt					
	½" Thick		¾" Thick		1" Thick		½" Thick		¾" Thick		1" Thick	
Inches	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections	Lineal Feet	No. of Sections
½	180	60	120	40	81	27	180	60	120	40	81	27
¾	144	48	102	36	69	23	144	48	102	36	69	23
1	117	39	81	27	60	20	117	39	81	27	60	20
1¼	90	30	69	23	54	18	90	30	69	23	54	18
1½	72	24	60	20	45	15	72	24	60	20	45	15
2	60	20	45	15	36	12	60	20	45	15	36	12
2½	45	15	36	12	33	11	45	15	36	12	33	11
3	45	15	36	12	30	10	33	11	27	9	21	7
3½	42	14	30	10	27	9	24	8	21	7	18	6
4	39	13	27	9	24	8	21	7	18	6	18	6
5	27	9	21	7	15	5	12	4	12	4	9	3
6	21	7	15	5	12	4	9	3	9	3	6	2

EHRET'S ANTI-SWEAT PIPE COVERINGS

If cold water lines are not protected from contact with the air, atmospheric moisture is likely to condense and drip during humid weather conditions. Especially designed to prevent such condensation, Ehret's Anti-Sweat Pipe Coverings are commonly used on cold water service lines in buildings, warehouses, processing rooms and other locations where pipe sweating would be undesirable, costly or dangerous. These highly-moisture-resistant sectional coverings are also used to keep cold water lines from warming up in hot weather.

Anti-Sweat Pipe Coverings are structurally strong and are easy to handle and apply. They are constructed, in single and double layer types, of flat wool felt paper and asphalt-saturated asbestos paper. A factory-weight canvas jacket is attached to the outer surface of each covering, and their general construction is shown in the accompanying illustration. For best efficiency the double layer coverings should be used, as the staggering of joints reduces the possibility of air infiltration.

When Anti-Sweat coverings are to be installed in weather-exposed locations, a suitable weatherproofing should be provided.

Furnished in 3-foot lengths for standard pipe sizes ranging up to 6 inches, Ehret's Anti-Sweat Pipe Coverings are available in single and double layer construction. Thicknesses of ½" and ¾" are available in single layer only, and coverings 1" and greater in thickness are available in double layer only. Packed in crates or cartons, as desired, with sufficient bands for application.

EHRET'S ANTI-SWEAT PIPE COVERINGS

Heat Transmission, in BTUs per Square Foot of pipe surface per Hour per Degree F. temperature difference between pipe and air. (Based on 50° temp. difference.)

Pipe Size Inches	Thickness of Covering, in Inches				
	½	¾	1	1½	2
½	1.012	.890	.801	.676	.600
¾	.944	.812	.713	.610	.532
1	.883	.748	.660	.550	.482
1¼	.826	.691	.605	.497	.435
1½	.800	.662	.576	.473	.405
2	.760	.625	.541	.436	.365
2½	.723	.595	.513	.409	.346
3	.711	.574	.490	.387	.330
3½	.698	.559	.475	.374	.314
4	.687	.550	.466	.365	.311
4½	.676	.529	.447	.358	.296
5	.665	.524	.442	.343	.282
6	.660	.516	.432	.331	.268

PACKAGING DATA
Anti-Sweat Coverings, 1" thick

Pipe Size, Inches	Sections per Crate	Weight, Pounds	Pipe Size, Inches	Sections per Crate	Weight, Pounds
½	105	450	2	45	280
¾	90	400	2½	36	260
1	72	380	3	30	230
1¼	68	360	3½	25	200
1½	56	320	4	20	185

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EHRET'S FROSTPROOF PIPE COVERINGS

Ehret's Frostproof Pipe Coverings are used on piping in unheated walls, rooms, warehouses and in other locations that are likely to be exposed to temperatures moderately lower than 32° F. Furnished in sectional form, these coverings are easy to handle, work and apply.

Combining the desirable characteristics of two well-known insulating materials, Ehret's Frostproof Pipe Covering is designed specifically to prevent freezing. The hair felt in these coverings gives them good insulating efficiency and the flat wool paper provides structural strength and protection for the hair felt. Saturated felt liners are provided on the inner surfaces of the coverings.

Where temperatures considerably lower than 32° F. are likely to be encountered, or where the periods of exposure to freezing temperatures might be of considerable length, Ehret's Standard Hair Felt of the proper thickness should be applied instead of the Frostproof coverings.

When Frostproof coverings are to be installed in weather-exposed locations, a suitable weather-proofing should be provided.

Available Sizes

Furnished in standard 3-foot lengths with canvas pasting jacket and bands, Frostproof Pipe Coverings are available in 1¼" thickness only for standard pipe sizes up to 6-inch. These sectional coverings are also available in sizes to fit straight copper pipe and tubing of the following outside diameters: ⅜", ½", ⅝", ⅞", 1⅛", 1⅜", 1⅝", 2⅛", 2⅝", 3⅛", 3⅝", 4⅛", 5⅛" and 6⅛". Normally packed in cartons, Frostproof coverings will be packed in crates if desired.

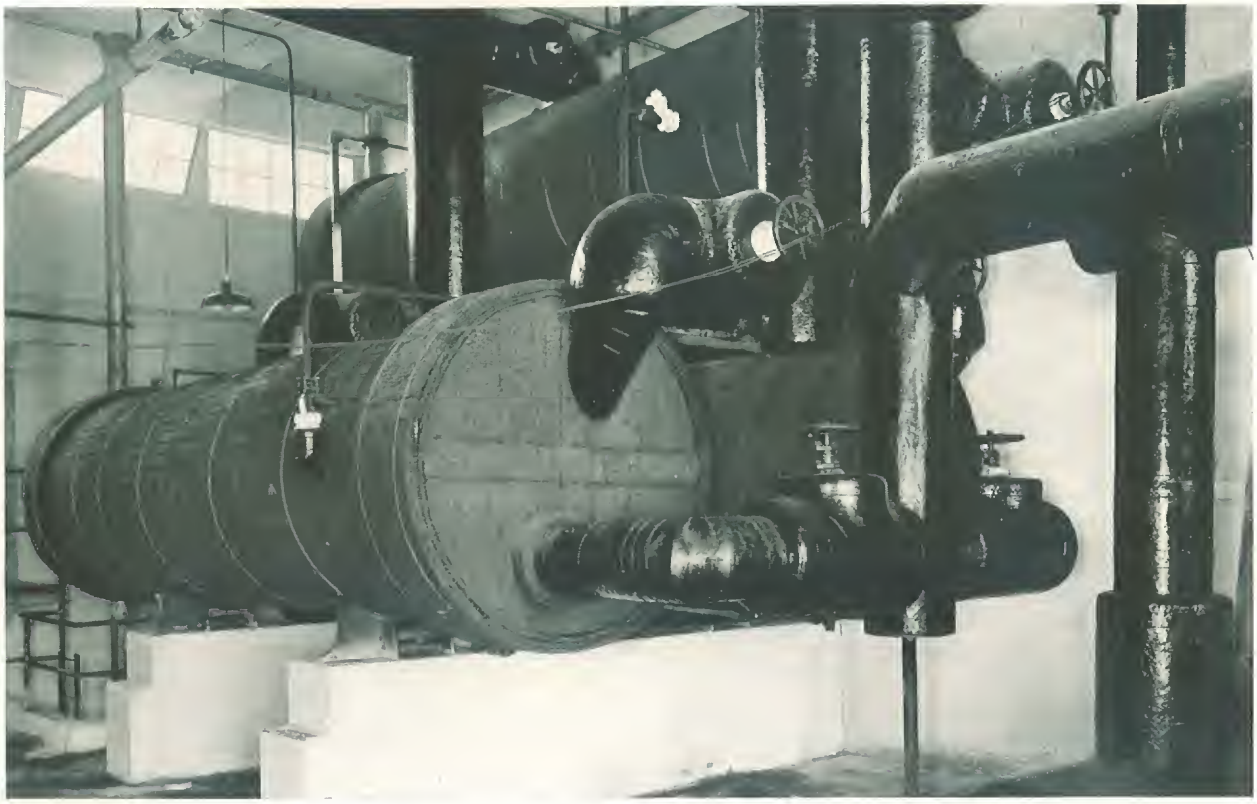
EHRET'S FROSTPROOF PIPE COVERINGS

Heat Transmission, in BTUs per Square Foot of pipe surface per Hour per Degree F. temperature difference between pipe and air. (Based on 50° temp. difference).

Pipe Size, Inches	Heat Transmission
½	.605
¾	.547
1	.495
1¼	.450
1½	.423
2	.400
2½	.377
3	.360
3½	.349
4	.340
4½	.332
5	.324
6	.316

PACKAGING DATA
Frostproof Coverings, 1¼" thick

Pipe Size, Inches	Sections per Carton	Weight, Pounds
½	23	60
¾	20	57
1	18	52
1¼	15	50
1½	12	47
2	11	45
2½	9	43
3	8	42
3½	8	40
4	7	38



EHRET'S CORK INSULATIONS . . .

The cork oak tree is the source of the widely used substance known as "Cork." This unique tree, which grows in certain sections of Spain and northern Africa, is stripped at intervals of its protective outer bark to provide industry with a natural material of extraordinary characteristics and broad commercial use.

Chief among cork's desirable physical properties are its insulating value and low density. A microscopic study of the internal structure of cork shows a high percentage of irregularly-shaped minute cells containing entrapped air, which accounts for both its low thermal conductivity and extremely light weight. The solid substances that form the walls of these minute dead-air spaces are relatively inert chemically and consequently at normal or low temperatures cork will last indefinitely.

In the manufacture of cork insulations, the rough cork bark is cleaned, processed and ground into granular form. Molded shapes, including sectional pipe coverings, lagging, pipe fitting coverings and blocks are made by firmly compressing granular cork into molds which are then baked at carefully controlled temperatures for accurately predetermined periods of time. The baking process drives off residual moisture and softens natural resinous components of the cork so that on removal from the molds, the granulated cork is found to be bonded by the heat and pressure into a firm, durable shape. These molded shapes are then carefully trimmed and sawed into standard or special forms of the desired dimensions.

Although most cork insulation is furnished and applied in molded forms, granulated cork is sometimes used as a loose fill insulation. When mixed with melted paraffin, granulated cork can be poured into joints or spaces between coverings and pipe fittings.

Actual size photo of molded cork

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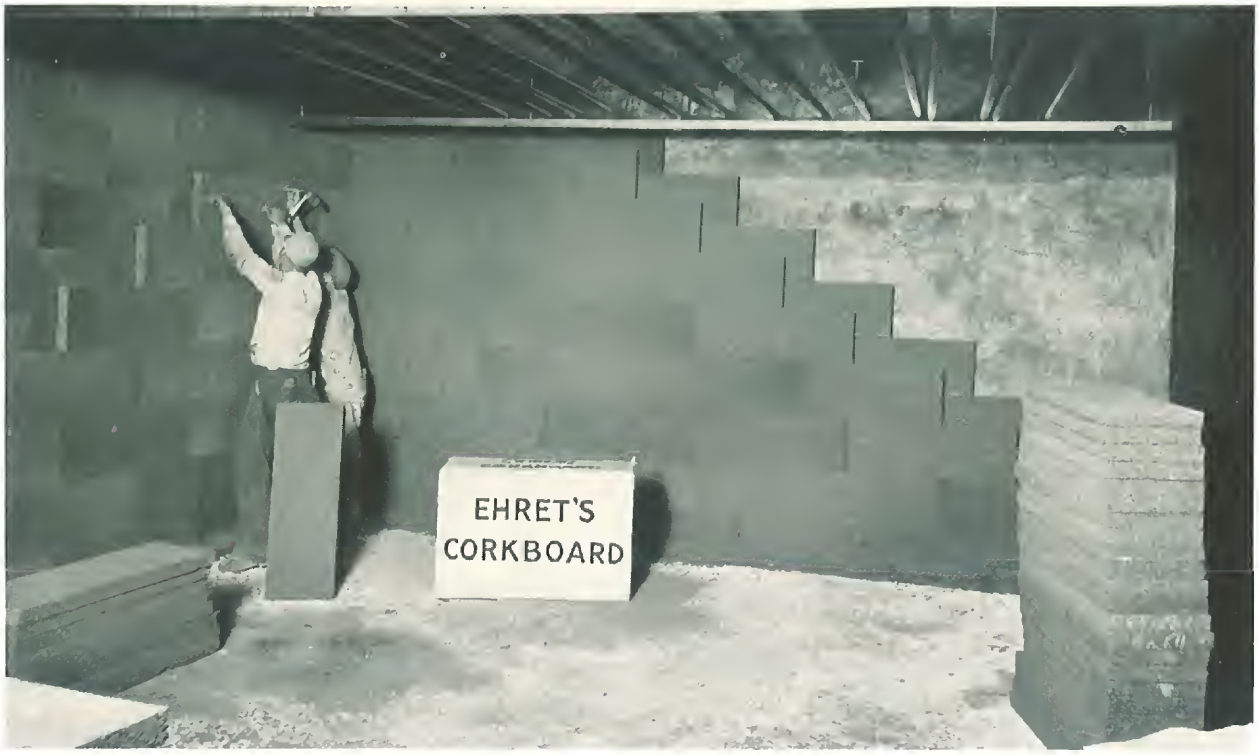

Ehret's Corkboard is an excellent material for such uses as pictured here. The cold-room shown above is being lined with two 2″ layers of Corkboard, and the roof shown below is being insulated to keep the building temperatures low in summer and to save heat in winter.

EHRET'S CORK PIPE COVERINGS

Ehret's Cork Pipe Coverings are made in sectional and segmental form to fit standard pipes as well as brass and copper pipe and tubing. Made in standard 3-foot lengths, the following thickness classifications of sectional forms are available:

1. Ice Water Thickness
2. Brine Thickness
3. Special Thick Brine

Sectional cork pipe coverings and two-piece fitting coverings are available for all of the more commonly used pipe sizes, and these sectional forms are coated on the outer surfaces with a smooth, tough mastic finish.

For large pipe sizes, cork pipe coverings are furnished in segmental form. Edges of all segments are beveled so as to fit close and tight, and both inner and outer surfaces are coated with the mastic finish. This segmental insulation (lagging) is available in standard single thicknesses from 1½" to 4", but can be furnished on special order in multiple-layer type to any thickness desired.

Standard cork coverings for fittings will match with the adjacent pipe insulation. The thicknesses and outer finish are identical and the connecting joints will fit tight and square. Coverings for large fittings can be made at the factory, on specification.

Where cork coverings are required for brass or copper pipe or tubing, the exact outside diameter of the pipe or tubing should be given. For steel or wrought iron pipe, the nominal pipe size will be sufficient.

Complete information should be given when ordering cork coverings for valves or fittings. This should include size, shape, weight (standard 125 lb., extra heavy 250 lb., etc.), type of connections (screwed, flanged, etc.). For all special valves and fittings, the name of the manufacturer and the number of the fitting should also be given.

Recommended Thicknesses

In addition to knowing the temperatures to be covered by cork insulation, certain other factors such as the temperature of the surrounding air should be considered before a final specification of thickness is made. The following recommendations are offered as a general guide for average requirements.

Ice Water Thickness is usually specified for use on chilled drinking water lines that are subjected to normal room temperatures. Where lines pass through rooms having subnormal air temperatures, these coverings may well be used on temperatures as low as 25° F.

Brine Thickness coverings are designed for use on piping whose temperatures range down to 0° F. This thickness is frequently used on ice water services where the temperatures of the surrounding air are likely to be relatively high.

Special Thick Brine is the thickest standard sectional cork covering and should be specified for use on temperatures down to about minus 25° F.

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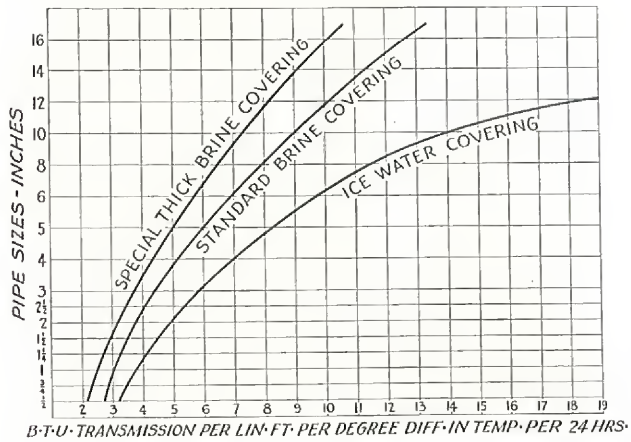
TABLE OF THICKNESSES		
Type of Cork Pipe Covering	Thickness in Inches*	Temperature Range
Ice Water Thickness	1.21 to 1.81	(See thickness recommendations on preceding page.)
Brine Thickness	1.71 to 3.00	
Special Thick Brine	2.52 to 4.00	

* Depending on pipe sizes.

Applications

In applying molded cork shapes to piping, flanges, valves and fittings, care should be taken that all metal surfaces are clean and perfectly dry. After it is ascertained that the cork shapes will fit accurately and closely on the metal surfaces, they should be firmly applied with all joints set up in a waterproof cement, making sure that there are no cracks left which will permit air to enter. The pipe covering sections should be so placed that the longitudinal joints are along the top and bottom of the pipes.

Molded cork coverings are available for practically all of the more commonly used sizes of pipe fittings. They fit snug and tight and are easy to apply.



All pipe covering shapes are to be held in place by means of Copperweld wire, having not less than six separate wire loops to each 3-foot section. These wires should be circumferentially straight around the covering and are to be drawn tight by twisting the ends with pliers. Wire ends should be bent over and pressed into the surface to avoid projections. Molded coverings for pipe fittings should be cross-wired diagonally so that the wires will not slip off.

Where there are screwed fittings, the cork fitting coverings should be applied *before* the pipe coverings. Coverings for flanges should be applied *after* the pipe coverings since they rest upon the outer surface of the pipe insulation.

All recesses between the coverings and metal surfaces are to be filled with Ehret's Cork Filler, and seams should be smoothed up with Ehret's Seam Filler.

For indoor lines the entire outer surface of the cork insulation should be given a good coating of a cork covering paint. Outdoor lines should be protected with a suitable weatherproofing.

Ehret's Cork Pipe Covering fully meets the Navy Specification No. 32C12 dated Dec. 1, 1933 and the Federal Standard Specification No. HH-P-381 dated April 3, 1934.

HEAT LOSSES FROM BARE IRON PIPES

BTUs per Lineal Foot per Degree F. temperature difference between pipe and air, per 24 hours.

Pipe Size	BTUs	Pipe Size	BTUs
¼	10	4	58
⅜	11	5	70
½	13	6	84
¾	16	8	105
1	19	10	130
1¼	24	12	150
1½	27	14	165
2	33	16	191
2½	39	18	215
3	46	20	240
3½	52		

Care and Upkeep of Cork Pipe Coverings

Ehret's Cork Pipe Coverings should be given a coat of Ehret's Cork Covering Paint at least once every year. Before painting, all wires and joints should be inspected and repairs made where necessary. On outdoor pipe lines, the weatherproofing should be carefully inspected at regular intervals, and care should be taken to prevent the entrance of moisture.

When properly serviced and kept in good condition, cork pipe coverings should last indefinitely. Conscientious inspections at six month intervals, followed by immediate rewiring and repainting where needed, are requisites for maintaining insulation efficiency and ensuring long service life.

EHRET'S CORK PIPE COVERINGS

Dimensions and Weights

ICE WATER THICKNESS COVERING						BRINE THICKNESS COVERING				SPECIAL THICK BRINE COVERING			
Pipe Size Inches	O. D. Pipe Inches	O. D. Covering Inches	Thickness of Wall Inches	Net Weight Per Lineal Foot—Lbs.	Feet Per Crate	O. D. Covering Inches	Thickness of Wall Inches	Net Weight Per Lineal Foot—Lbs.	Feet Per Crate	O. D. Covering Inches	Thickness of Wall Inches	Net Weight Per Lineal Foot—Lbs.	Feet Per Crate
¼	.540	J 3.25	1.36	1.20	225	J 4.25	1.86	1.99	132	J 5.88	2.67	3.96	66
⅜	.675	J 3.25	1.29	1.28	225	J 4.25	1.79	1.92	132	J 5.88	2.60	3.95	66
½	.840	J 3.25	1.21	1.25	225	J 4.25	1.71	1.98	132	J 5.88	2.52	3.93	66
¾	1.050	J 3.75	1.35	1.56	166½	J 4.75	1.85	2.37	105	J 6.38	2.67	3.89	57
1	1.315	J 4.25	1.47	1.89	132	J 5.38	2.03	2.79	81	J 7.25	2.97	5.07	43½
1¼	1.660	J 4.50	1.42	2.13	123	J 6.38	2.36	3.76	57	J 7.88	3.11	5.83	36
1½	1.900	J 4.75	1.43	2.15	105	J 6.88	2.49	4.47	51	J 7.88	2.99	5.74	36
2	2.375	J 5.38	1.50	2.45	81	J 7.25	2.44	4.73	43½	J 8.88	3.25	7.04	28½
2½	2.875	J 5.88	1.50	2.60	66	J 7.88	2.50	5.35	36	J 9.63	3.38	6.82	25½
3	3.500	J 6.88	1.69	3.37	51	J 8.88	2.69	6.49	28½	J 10.13	3.32	7.69	21
3½	4.000	J 7.25	1.63	3.87	43½	J 9.63	2.81	7.39	25½	J 11.13	3.57	10.06	18
4	4.500	J 7.88	1.69	4.36	36	J 10.13	2.81	7.04	21	J 12.25	3.88	9.71	15
5	5.563	J 8.88	1.66	4.96	28½	J 11.13	2.78	8.78	18	J 13.25	3.84	12.95	12
6	6.625	J 10.13	1.75	6.19	21	J 12.25	2.81	9.89	15	J 14.5	3.94	15.42	12
8	8.625	J 12.25	1.81	7.56	15	J 14.50	2.94	12.95	12	L 16.63	4.00	16.56	12
10	10.750	L 13.75	1.50	9.64	12	L 16.75	3.00	13.94	12	L 18.75	4.00	19.18	9½
12	12.750	L 15.75	1.50	8.24	10	L 18.75	3.00	15.81	10	L 20.75	4.00	21.65	9
14	14.000	L 17.00	1.50	8.95	9	L 20.00	3.00	17.00	10	L 22.00	4.00	23.18	8
16	16.000	L 19.00	1.50	10.05	9	L 22.00	3.00	19.03	9	L 24.00	4.00	25.46	7
18	18.000	L 21.00	1.50	11.11	8	L 24.00	3.00	20.88	8	L 26.00	4.00	28.17	6
20	20.000	L 23.00	1.50	12.21	8	L 26.00	3.00	22.84	8	L 28.00	4.00	30.25	6

J—Molded. L—Lagged.

Accessories for Applying Ehret's Cork Pipe Covering

With each order of Ehret's Cork Pipe Covering, the following accessories are furnished:

EHRET'S WATERPROOF CEMENT—used for cementing the joints. It is not affected by brine or ammonia fumes or by moisture. Spreading capacity: one gallon to every 35 square feet of joint area. Weight: 14 pounds to a gallon, crated.

EHRET'S CORK COVERING PAINT—used to paint the outside of the covering after it has been applied. Spreading capacity: one gallon to every 150 square feet of covering surface. Weight: 11 pounds to a gallon, crated.

EHRET'S PUTTY—used as a filler for any spaces between the covering and the fittings. Use Ehret's Putty only for filling; never for sealing joints or on the outside of the covering. Weight: 66 pounds to each cubic foot, crated.

EHRET'S SEAM FILLER—used to smooth up seams or edges accidentally chipped in application of the covering. Spreading capacities: For sectional covering, 4.5 pounds per 100 feet. For lay covering, 9 pounds per 100 feet. For fitting jackets, 9 pounds per 100 jackets. For lag fittings, 18 pounds per 100 fittings.

COPPERWELD STEEL WIRE—used to hold the covering snugly against the pipe. It is a special copperclad steel wire combining the strength of steel with the ability of copper to resist corrosion. Pure copper, steel or galvanized wire will give satisfactory service, and the accompanying table shows recommended Copperweld wire sizes.

RECOMMENDED WIRE SIZES						
Brine Thickness Covering	Ice Water Thickness Covering	Spec. Thick Brine Covering	B. & S. Wire Ga.	Dia. of Wire Inches	Feet Per Lb.	Wt. Per Lineal Foot of Wire Lbs.
¼" to 1½"	¼" to 3"	¼" to ¾"	14	.064	86.95	.0115
2" to 8"	3½" to 10"	1" to 6"	12	.081	54.63	.0183
9" to 16"	12" to 16"	7" to 16"	10	.102	34.36	.0291

Spacing Data

When pipe lines are laid out, space must be allowed for the application of covering of the right thickness. Also bear in mind the size of the fitting insulation and be sure to allow enough space so that cork fitting covers can be applied on every fitting without having to cut away any cork.

TYPES AND SIZES OF FITTINGS	Space Between Parallel Pipes	Space Between Pipes and Adjacent Surfaces
BRINE THICKNESS		
Screwed Fittings up to and including 6-inch	8 inches	6 inches
Screwed Fittings larger than 6-inch	14 inches	8 inches
Flanged Fittings	14 inches	8 inches
SPECIAL THICK BRINE		
Screwed Fittings up to and including 3-inch	10 inches	8 inches
Screwed Fittings larger than 3-inch	18 inches	12 inches
Flanged Fittings	18 inches	12 inches
ICE WATER THICKNESS		
Screwed Fittings up to and including 6-inch	6 inches	4 inches
Screwed Fittings larger than 6-inch	10 inches	5 inches
Flanged Fittings	10 inches	5 inches

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INSULATIONS

Wall and Floor Sleeves

All openings in walls and floors must be large enough to allow the full thickness of covering to pass without cutting. This insures a continuous tight job and eliminates the frost and drip always found where covering butts against walls and floors.

Pipe Hangers

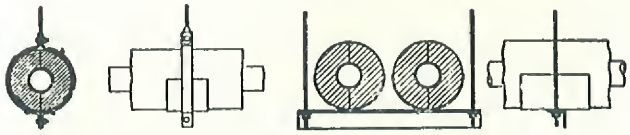


Fig. 1
Strap Hanger

Fig. 2
Trapeze Hanger

All pipe lines to be insulated with Ehret's Cork Coverings should be supported by hangers and the covering protected by a sheet iron shield where the pipe rests in the hanger. This shield should be shaped to fit the covering and should extend 4" away from each side of the hanger (see above illustration) and should extend up the sides to the level center of the pipe. Never under any circumstances should the hanger be applied direct to the pipes.

Molded Cork Coverings and Cork Centers

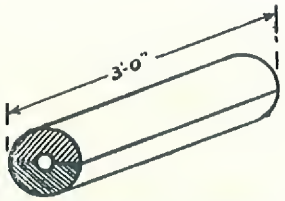


Fig. 1 Three sectional feet of molded Cork Covering

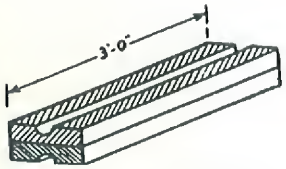


Fig. 2 Three sectional feet of molded Cork Centers

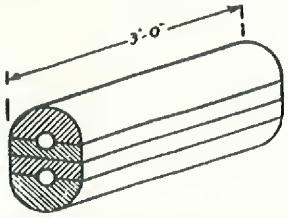


Fig. 3 Insulation of pipes that are too close together for two regular sectional coverings

The sizes of pipes and distances between centers should be specified when ordering molded Ehret Cork Centers. A sketch showing the requirements should be submitted to eliminate possibility of error when ordering material.

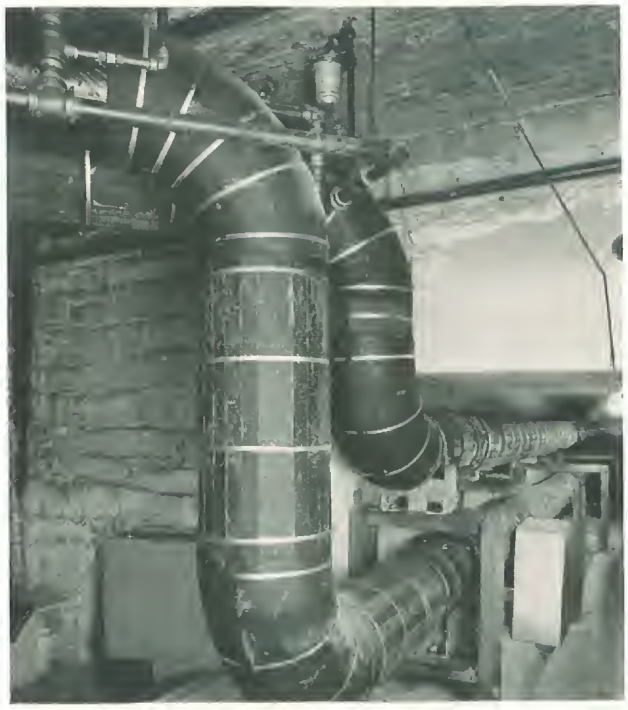
EHRET'S CORK LAGGING AND DISCS

Frequently required for covering tanks and large piping and equipment, Cork Lagging and Discs are available in a broad range of shapes, sizes and thicknesses. The material regularly furnished is of Corkboard density, but a denser and stronger cork, of 1.2 pounds per board foot, is also available at additional cost.

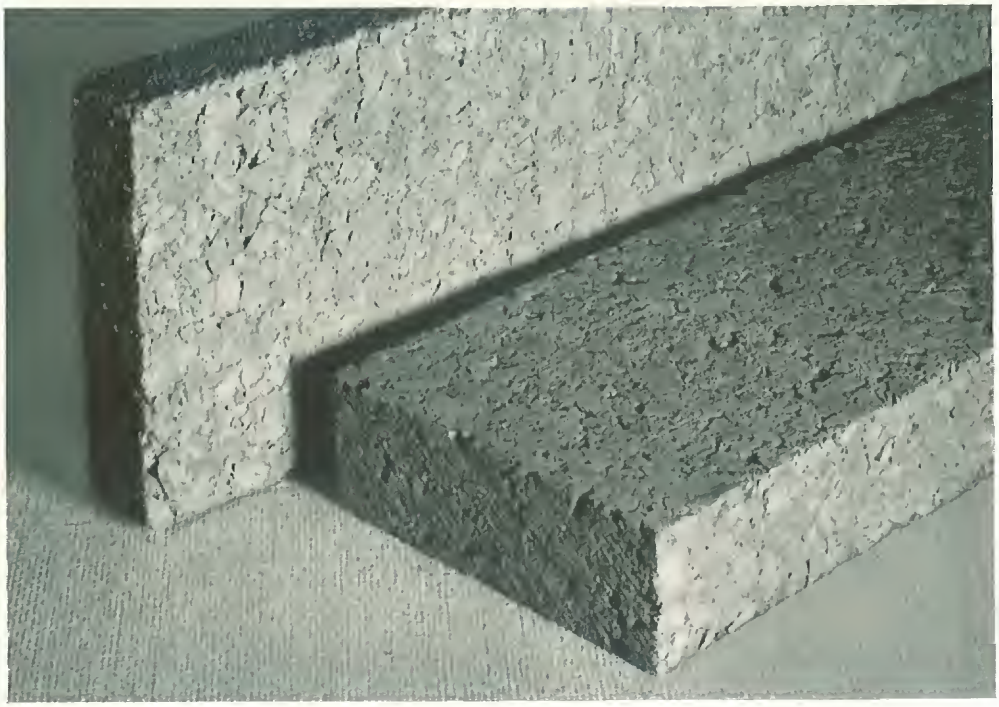
These shapes are normally furnished coated, but can be supplied plain and lagging can be furnished, when desired, with coated ends. Thicknesses up to 10" are available in both lagging and discs, and thickness recommendations for various temperatures are normally the same as listed for Ehret's Corkboard.

The many sizes and styles of equipment on which these materials can be used make it absolutely essential that each order be accompanied with detailed specifications and blueprints giving accurate measurements. Materials will then be supplied in proper lengths, widths and bevels to accurately fit the surfaces.

In arriving at number of square feet in Discs, diameter should be squared and resulting figure raised to next even square foot. Discs up to three feet in width furnished solid unless otherwise specified. Discs up to six feet in width furnished split with straight joint. Discs over six feet in width furnished split with rabbetted joint. In figuring Discs over six feet in diameter, add thickness of material to diameter of Disc to allow for rabbetted joint.



All Ehret's Cork Lagging and Discs are packed in wooden crates.



EHRET'S CORKBOARD . . .

Ehret's Corkboard is used as insulation on a variety of services. It is applied to ceilings, walls and floors of cold storage rooms; as roof insulation on factories and warehouses to eliminate condensation and to minimize seasonal variations of room temperatures; and as a covering on air conditioning ducts and equipment.

In addition to having very good thermal efficiency, Ehret's Corkboard has considerable mechanical strength, which makes it a desirable material to use for the insulating structure of cold-rooms. When properly installed it will remain solidly and permanently in place, and will not swell or shrink under normal service conditions. Being resilient, tough and light, it is an excellent material to handle, work and apply. It will not mould or decay and, although not fireproof, it is fire-resistant.

Ehret's Corkboard is made from the same materials and in the same general manner as Ehret's Cork Pipe Coverings, and is available in the following machine-finished standard sizes:

12 inches wide x 36 inches long
24 inches wide x 36 inches long

in thicknesses of 1″, 1½″, 2″, 3″ and 4″.

All surfaces of Ehret's Corkboard are finished even, square and true. If desired, either one or both sides of the Corkboard will be sanded, at a slight additional charge.

TEST DATA
On Various Board–Type Insulating Materials

Material	Thermal Conductivity in BTUs	Relative Insulating Value	Impact Penetration	Compression Test	
				Depressed	Recovery
Corkboard	0.277	100.0	.06″	.267″	.184″
Wood Fibre Board	0.322	86.3	.31″	.098″	.045″
Mineral Wool Board	0.324	85.8	.92″	.607″	.139″
Vegetable Fibre Board	0.356	78.1	.38″	.224″	.099″

Impact test consisted of 2″ hemispherical hammer of 7 lbs. attached to 51″ pendulum swinging through an 80° arc and striking 12″ x 12″ x 2″ specimen at lowest point of swing.
Compression test was made by loading 4″ x 4″ x 2″ specimen with 10 lbs. for 120 hours.

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Application of Corkboard

The details of corkboard applications are likely to vary in accordance with individual conditions. The Ehret Company will be glad to furnish application details for fully described insulation needs.

Care should be taken that all surfaces on which Corkboard insulation is to be applied are made thoroughly clean and dry. Where waterproof sealing or adhesive compounds are to be used, they should be generously applied in a uniformly thick coating so as to prevent air infiltration.

Ehret's Corkboard fully meets Navy Specification No. 32C5C dated December 1, 1937 and Federal Standard Specification No. HH-C-561 dated June 6, 1933 and Amendment No. 1, dated Nov. 1936.

Packaging

Ehret's Corkboard is packed in tubes containing 36 board feet, in cartons containing 72 board feet and is sometimes shipped in bulk. Shipping weights are given in the accompanying table:

CORKBOARD SHIPPING WEIGHTS, Per Board Foot

In Tubes	In Cartons	In Bulk
.8 pounds	.9 pounds	.75 pounds

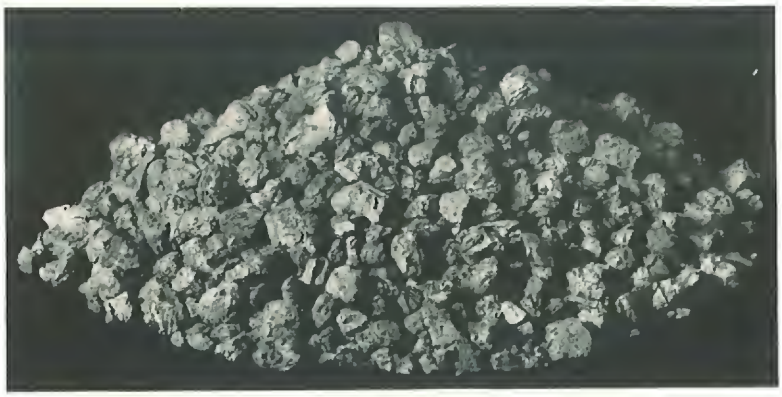
On shipments of up to 25,000 board feet, Ehret's Corkboard will be furnished as desired by the purchaser, in tubes, cartons or bulk. (Subject to the regulations of the carrier.) On shipments of more than 25,000 board feet, Corkboard will be furnished in tubes or in bulk, at the option of the purchaser.

EHRET'S CORKBOARD—Recommended Thicknesses

Temp. (deg. F.)	Cork Thick.	Temp. (deg. F.)	Cork Thick.
45° and up	2″	5° to 20°	5″
35° to 45°	3″	−5° to 5°	6″
20° to 35°	4″	−20° to −5°	8″

EHRET'S CORK INSULATION SUNDRIES

Product	Weight	Container
Aluminum Paint	10 lbs./gal.	½ and 1 gal. cans
Asphalt Emulsion, Primer and Trowel Coat	9½ lbs./gal.	10, 35 and 55 gal. drums
Special Head Galvanized Nails	100 lbs./keg	wooden keg
Insulating Paper	38 lbs./roll	500 sq. ft. rolls
Hardwood Skewers:		
4½ inch long	5½ lbs./M	—
5½ inch long	6½ lbs./M	—
7 inch long	9 lbs./M	—
Erection Asphalt	450 lbs./drum	Metal Drums



EHRET'S GRANULAR CORK

There is occasional need for a fill-type of cork insulation, such as in filling small, odd-shaped air-spaces between metal surfaces and the applied molded forms. Ehret's Granulated and Regranulated Cork are used for such purposes.

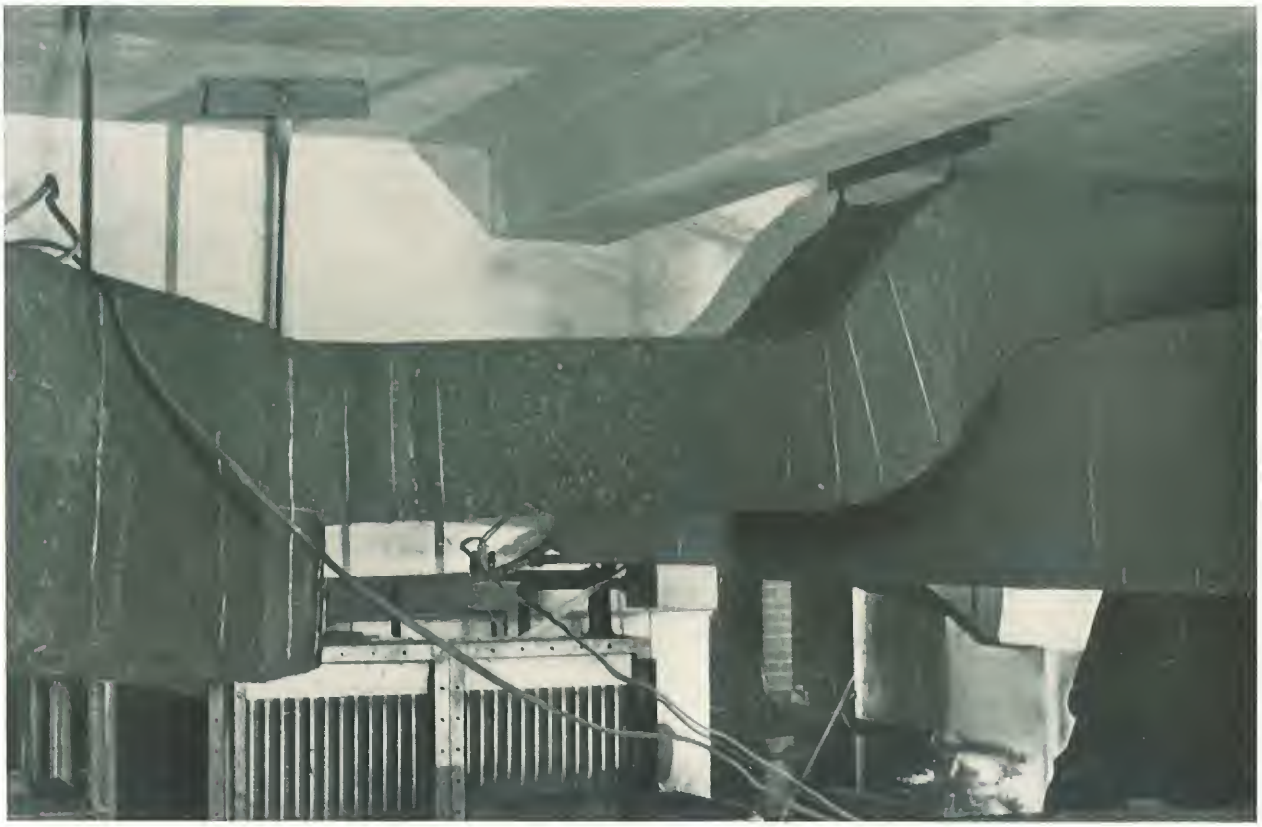
The accompanying table lists the several types of this material.

Granular Cork is packed in burlap bags of net weights ranging between 50 and 60 pounds.

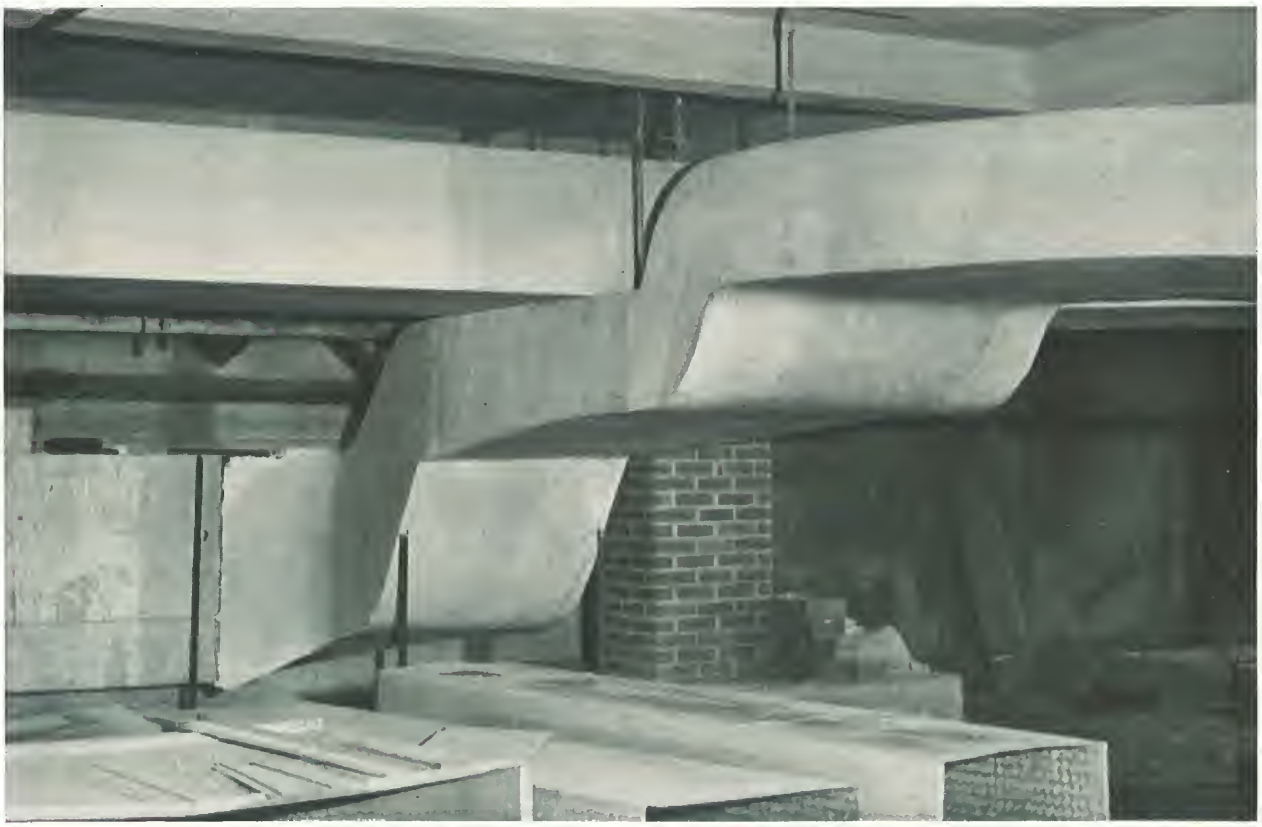
Granular Cork is not recommended for use in large spaces when the application of molded cork shapes is practical.

EHRET'S GRANULAR CORK

Type	Weight
Fine Regranulated	6½ lbs. per cu. ft.
Coarse Regranulated	5½ " " " "
Mixed Regranulated	5¾ " " " "
8/20 Granulated (Natural)	8¼ " " " "



EHRET'S CORKBOARD applied to air-conditioning ducts. The illustration above shows the Corkboard wired into place, and below is shown the smooth plaster finish over the Corkboard.



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Heat Transmission Through Structures

BTUs per Square Foot per Hour per Degree F. temp. diff. air to air

Type of Structure	No Insulation	Insulated with Corkboard, Thickness in Inches						
		1½	2	3	4	5	6	8
MASONRY WALLS								
Common Brick 4″	.63	.149	.121	.080	.063	.054	.045	.036
" " 8″	.44	.130	.107	.077	.060	.051	.042	.034
" " 12″	.31	.118	.097	.072	.057	.048	.040	.032
" " 16″	.25	.110	.092	.069	.055	.047	.039	.031
Face Br.—4″ Com. Br. 0″	.81	.163	.132	.083	.066	.056	.047	.038
" "—4″ " " 4″	.49	.136	.111	.078	.061	.052	.043	.035
" "—4″ " " 8″	.35	.121	.100	.074	.058	.049	.041	.032
" " 4″ " " 12″	.28	.114	.094	.070	.056	.048	.040	.031
Cut Stone 8″	.68	.152	.124	.081	.064	.055	.046	.037
" " 12″	.56	.142	.116	.079	.062	.053	.044	.035
" " 16″	.47	.134	.109	.078	.061	.052	.043	.034
" " 24″	.36	.122	.101	.074	.058	.049	.041	.033
Hollow Clay Tile 4″	.53	.140	.114	.079	.062	.053	.044	.035
" " " 8″	.39	.126	.103	.075	.059	.050	.041	.033
" " " 10″	.35	.121	.100	.074	.058	.049	.040	.032
" " " 12″	.31	.118	.097	.072	.057	.048	.040	.032
" " " 16″	.24	.109	.090	.068	.054	.046	.039	.030
Cinder Block 8″	.42	.129	.106	.077	.060	.051	.042	.034
" " 12″	.36	.122	.101	.074	.058	.049	.041	.033
Concrete Block 8″	.56	.142	.116	.089	.062	.053	.044	.035
" " 12″	.49	.136	.111	.078	.061	.052	.043	.034
Poured Concrete 6″	.80	.162	.131	.083	.066	.056	.047	.038
" " 8″	.68	.152	.124	.081	.064	.055	.046	.037
" " 10″	.62	.148	.120	.080	.063	.054	.045	.036
" " 16″	.47	.134	.109	.078	.061	.052	.043	.034
" " 20″	.41	.127	.105	.076	.059	.050	.042	.033
WOOD FRAME WALLS (2″ x 4″ Studding)								
Clapboard —1″ Sheathing	.25	.110	.092	.069	.055	.047	.039	.031
Wood Shingle—1″ "	.24	.109	.090	.068	.054	.046	.038	.030
Stucco —1″ "	.31	.118	.097	.072	.057	.048	.040	.032
Brick Veneer —1″ "	.23	.108	.089	.067	.053	.045	.038	.029
WOOD FRAME PARTITIONS (2″ x 4″ Studding)								
Plaster—Wood Lath—one side	.60	.146	.118	.080	.062	.053	.044	.035
" —Metal " " "	.68	.152	.124	.082	.064	.055	.046	.037
CONCRETE FLOORS (Over Unfinished Ceilings)								
4″ Concrete	.63	.149	.121	.080	.063	.054	.045	.036
6″ "	.57	.143	.117	.079	.062	.053	.044	.035
8″ "	.52	.139	.113	.078	.061	.052	.043	.034
10″ "	.48	.135	.110	.077	.060	.051	.042	.033
(Directly on Ground)								
4″ Concrete	1.05	.178	.142	.088	.070	.058	.049	.040
6″ "	.89	.168	.135	.086	.068	.056	.047	.038
8″ "	.78	.161	.130	.084	.066	.055	.046	.037
10″ "	.69	.153	.125	.082	.065	.054	.045	.036
WOOD FRAME FLOORS AND CEILINGS (2″ x 4″ Joisting)								
Wood Flooring—one side	.45	.131	.108	.078	.061	.052	.043	.035
Plaster—Wood Lath—one side	.60	.146	.118	.080	.062	.053	.044	.036

RECOMMENDED STORAGE TEMPERATURES

In Degrees F.

According to Various Authorities

Apples	31 to 33
Asparagus	32 to 35
Beans (dried)	32 to 45
Beef (fresh)	33 to 37
Beef (dried)	36 to 40
Beer (barrels)	32 to 38
Beer (bottles)	45
Berries (fresh, 10 days)	35 to 40
Butter	10 to 32
Butter (to freeze)	20 to 22
Cabbage	31 to 35
Cantaloupes	40
Carrots	32 to 35
Celery	31 to 35
Cheese	28 to 35
Chestnuts	33 to 40
Chocolate (dipping room)	65
Chocolate (to cool)	40
Cider	30 to 35
Cigars	35 to 42
Cranberries	32 to 40
Cream	33 to 35
Cucumbers	36 to 38
Dates	45 to 55
Eggs	30 to 35
Fish (fresh)	20 to 30
Fish (fresh-water frozen)	17 to 20
Fish (canned)	33 to 36
Fish (dried)	25 to 40
Flowers (cut)	36
Fruits (canned)	30 to 40
Fruits (dried)	35 to 40
Furs (undressed)	35
Furs (dressed)	25 to 35
Game (frozen)	10 to 28
Game (to freeze)	0 to 20
Game (long carry)	10 to 28
Grapes	30 to 36
Ginger Ale	35 to 36
Hams (not brined)	20 to 35
Hogs	30 to 33
Honey	36 to 45
Hops	32 to 35
Ice	28
Ice Cream	15
Lard	33 to 40
Lemons	35 to 55
Lambs	32
Livers	20 to 30
Maple Syrup and Sugar	40 to 45
Meats (canned)	30 to 40
Meats (brined)	35 to 43
Meats (fresh)	33 to 35
Melons	35 to 36
Milk	32 to 38
Mutton (fresh)	32 to 35
Mutton (frozen)	25 to 28
Nuts (in shells)	30 to 40
Nursery Stock	30
Oatmeal	38 to 42
Oleomargarine	20 to 35
Onions	32 to 36
Oranges	32 to 45
Oxtails	30 to 32
Oysters (tubs)	25 to 35
Oysters (shells)	33 to 43
Parsnips	32 to 35
Peaches	31 to 45
Pears	30 to 36
Pork	20 to 34
Potatoes	34 to 50
Poultry (frozen)	10 to 30
Poultry (to freeze)	0 to 22
Poultry (long carry)	10 to 30
Raisins	55
Salt Meat Curing Room	32
Sardines (canned)	35 to 40
Sauerkraut	35 to 38
Sausage Casings	20 to 30
Scallops (frozen)	16
Syrup	35 to 45
Tobacco	35 to 42
Veal	32 to 34
Watermelons	34 to 40
Wines	40 to 50
Woolens	25 to 28

A low-cost insulation for use on air-conditioning ducts and equipment.

ERODUCT INSULATION . . .

This material has been developed especially for use on air-conditioning ducts and equipment. For certain installations where temperature differentials are relatively small its efficiency of approximately 75% is likely to be quite adequate. Since the applied cost of Ehret's Eroduct Insulation is lower than that of Standard Hair Felt or Corkboard, its use is indicated where the application of the more efficient and costlier materials might not be justified.

Ehret's Eroduct Insulation is a felt-like material that when applied, has a neat and attractive appearance. It is firm and tough, yet flexible; strong and sturdy, yet easy to cut with knife or shears. It can readily be fitted to round, rectangular or irregularly shaped surfaces and it requires no soaking or scoring for sharply bent corners. It is durable and will not chip, rot, break or harbor vermin. It can be applied to either the inside or the outside of ducts, and it is treated with a moisture-resisting latex coating.

In manufacturing this insulation, the two sides of the material are constructed in different manners. One side is asbestos-protected, moisture-proofed, patterned and finished, and this side should always be applied as the outside or exposed surface. The other side is the unfinished fibre surface that should always be placed on the glue-coated metal surface. In applying this material, it needs only to be cut to fit the surfaces and then fastened in place by means of the special adhesive which should be brushed onto the metal surface. After the material has been applied and firmly pressed into place, the special joint-sealing tape should be cemented on over the joints. This tape not only seals the crevices against the entrance of moisture, but also provides an attractive trim for the finished job.

In addition to having good thermal insulating value, Ehret's Eroduct Insulation is frequently used because of its sound-deadening characteristics. Tests have shown that on a typical duct lined with this material, 70% of the sound is absorbed within 10 lineal feet of the duct.

Ehret's Eroduct Insulation is neutral tan in color. Each roll of material is furnished with the necessary accessories for application. These accessories consist of a can of moisture-proof adhesive which is made especially for use with this material, and a roll of 2" wide asbestos-protected tape, of a harmonious tan color.

Ehret's Eroduct Insulation is made in ½" thickness only. Rolls are 36" wide and contain 100 square feet of insulation. Accessories are packed in the center of each roll. These rolls, packed for shipment, weigh approximately 45 lbs. and are easy to handle, stock and use.

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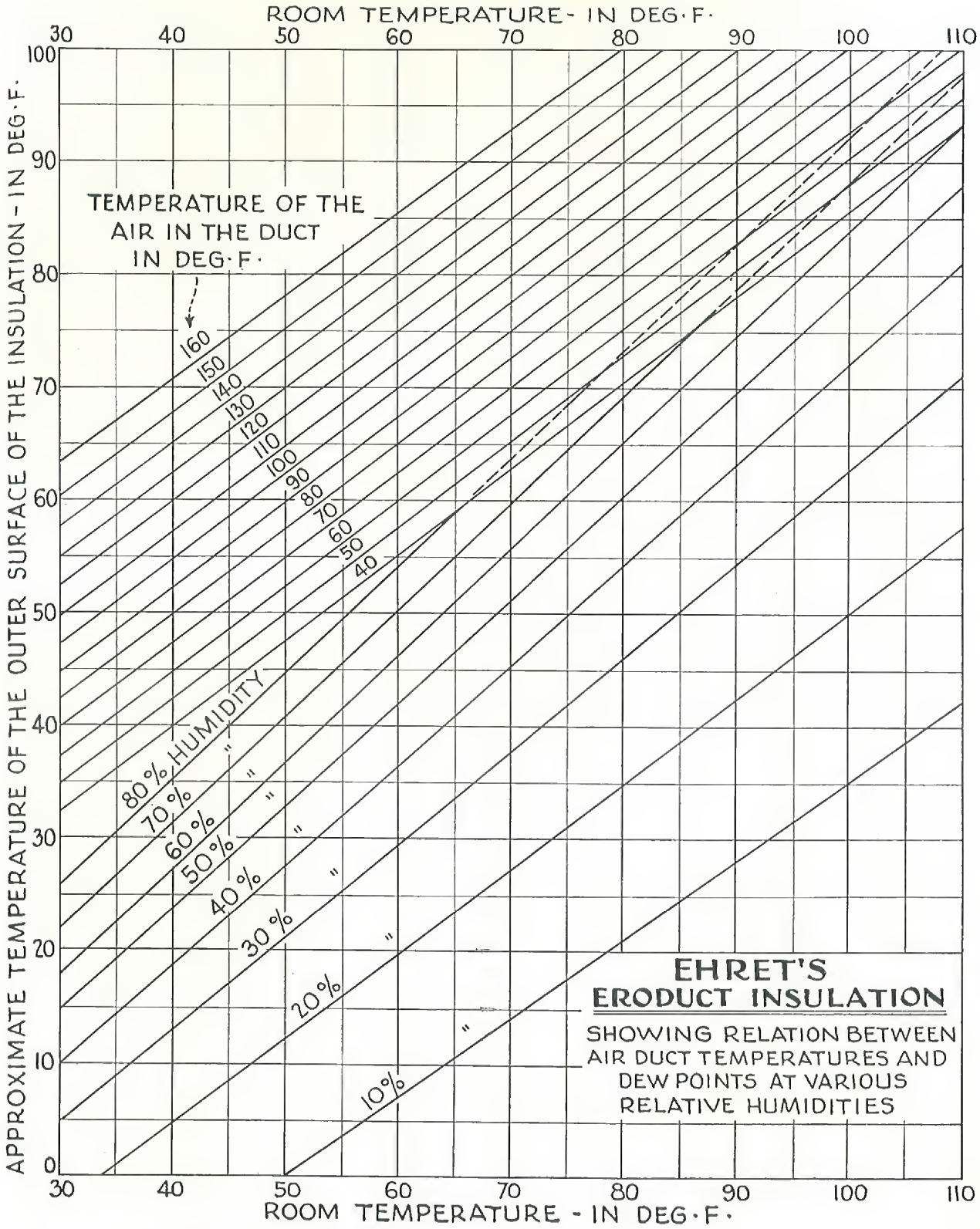
EHRET'S ERODUCT INSULATION

The dotted lines in this graph indicate the limits where moisture will condense on the outer surface of the insulation. When such conditions are likely to be encountered, a more efficient type of insulation, such as Hair Felt or Cork, should be used.



EHRET

INSULATION ACCESSORIES and FIREPROOFING MATERIALS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. IA 250

Printed in U. S. A.

EHRET'S FLAT ASBESTOS PAPERS . . .

Modern paper making machinery and methods are used to form asbestos fibres into Ehret's Asbestos Paper. Various grades of fibres are felted and bonded with a sodium silicate binding material to make the several grades of asbestos paper listed on both sides of this sheet.

Asbestos papers are used primarily for fireproofing where a thin, flexible material is required. There is no insulation value to these papers when flat and used separately. Where insulating efficiency is of importance Ehret's Asbestos Corrugated Paper may be used. Due to the addition of a special filler, Ehret's Asbestos Papers are white in color and relatively strong and tough in character. They are vermin proof and are not subject to rapid deterioration.

The broad range of uses for asbestos papers necessitate a variety of grades and thicknesses, and the following papers will answer practically all requirements:

Commercial Grade Paper

This is the most commonly used grade of asbestos paper and its uses include the following:

(1) Basic material for the manufacture of asbestos corrugated papers and air cell pipe coverings;
(2) Fire protection in wood partitions, walls, ceilings, etc.;
(3) Linings for stoves, ovens, gas ranges, electrical appliances, etc.;
(4) Wrappings on furnaces, flues and heater pipes;
(5) Used alone or in conjunction with thin copper sheets in making cylinder head and similar gaskets;
(6) Protection against acid and chemical fumes in rooms and equipment.

Where a great amount of permanency is desired, the heavier Commercial Grade asbestos papers such as the 14 lb., 16 lb. and $\frac{1}{16}$" papers are preferable to the 8 lb. and 10 lb. papers. In wrapping heater pipes, several layers of a 10 lb. or 12 lb. paper have more insulation value than a single layer of a heavier paper. The 6 lb. and 8 lb. papers are commonly used for backers between the plies and on the outside of air cell type pipe coverings, and also in the manufacture of asbestos corrugated paper. Some Neon sign manufacturers use this Commercial Grade asbestos paper in the fabrication of their products.

Commercial Grade asbestos papers are furnished in standard rolls of 18", 24" and 36" widths, weighing approximately 50 and 100 lbs. per roll. Special size rolls are available on request. All rolls are wound on heavy cardboard cores and are protected with a wrapping of stout manilla paper.

EHRET'S ASBESTOS PAPER
Commercial Grade
(Actual weights may vary plus or minus 10%)

Thickness, Inches	Weight per 100 sq. ft.
.015	6 lbs.
.019	8 lbs.
.022	10 lbs.
.027	12 lbs.
.029	14 lbs.
.032 ($\frac{1}{32}$")	16 lbs.
.0625 ($\frac{1}{16}$")	32 lbs.

ROLLBOARD

Thickness, Inches	Weight per 100 sq. ft.
.093 ($\frac{3}{32}$")	48 lbs.
.125 ($\frac{1}{8}$")	64 lbs.

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Asbestos Rollboard

Asbestos papers that are thicker than $\frac{1}{16}$" are commercially known as Rollboard. Compared to Millboard, this material is quite flexible, yet it has more stiffness and structural strength than is indicated by the word "paper." It is tough, strong and durable, yet is easily cut, worked and applied to curved surfaces.

Ehret's Asbestos Rollboard is frequently used in foundries and by welding companies instead of Gasket Grade asbestos paper because of its strength and durability. It is also used for wrapping exhaust manifolds, for general fireproofing in the automotive industry, for gaskets and as a flexible fireproof board. Ehret's Rollboard is available in Commercial Grade only, in rolls of 50 and 100 lbs. each and in widths of 18" or 36".

Non-Burn Grade Paper

Many specialized conditions require the use of a fireproof paper which will withstand temperatures up to 1000° F. Ehret's Asbestos Paper, Non-Burn Grade, will not disintegrate or be damaged in any way by temperatures up to this level. It is widely used for low voltage electrical insulation, on electrolytic equipment and for the filtration of chemicals. Manufacturers of Neon sign equipment use this grade of paper as standard because of its workability and dependable service life.

Non-Burn Grade asbestos paper is available in 100-lb. rolls, 36" wide, in $\frac{1}{16}$", $\frac{3}{32}$" and $\frac{1}{8}$" thicknesses.

Gasket Grade Paper

This material is the most durable of the asbestos papers. It has high tensile strength and is frequently used with temperatures as high as 1200° F. without deterioration. It is extremely resistant to acids and is widely used in the chemical industries. It is also used in the manufacture of metallic-asbestos gaskets and is frequently used alone as an asbestos paper gasket where excessively high temperatures are involved as on hot tar or oil vapor lines.

Gasket Grade asbestos paper is available in 100-lb. rolls, 36" wide, in specified thicknesses from .007 to .015 inches.

Long Fibre Grade Paper

The longer the asbestos fibre used in a paper, the stronger the finished product. Long Fibre Grade asbestos paper has been designed especially for use in conjunction with various welding operations. It will stand up under the severe service that is to be expected in this work, and it is practically unaffected in any way by the intense radiated heat and sparks of welding operations. The longer fibres in this material provide exceptional strength and it has the smokeless and non-disintegrating characteristics of the Non-Burn Grade.

Long Fibre Grade paper is furnished in ton lots only. It is available in 50 and 100-lb. rolls, 36" wide and in specified thicknesses from .019 to .0625 inches.

EHRET'S ASBESTOS PAPER FURNACE TAPE . . .

This material is commonly used for sealing joints in air cell coverings and asbestos corrugated papers during application to furnaces, pipes, ducts and flues. It is the same color as the regular papers and its use ensures a neat and air-tight insulation finish. It is readily applied with a cold water paste or silicate of soda cement.

This furnace or pipe joint tape is cut from Commercial Grade 12-lb. paper only, in widths of 2" and 3". It is furnished in packages containing eighteen rolls of 2" tape, or twelve rolls of 3" tape. Each roll contains approximately 85 lineal feet of tape.

OTHER ASBESTOS PAPER PRODUCTS

Special shapes and designs such as ferrules, tubings, discs, washers, gaskets, etc., will be made from Ehret's Asbestos Papers on order. Due to the innumerable variations possible in size, design and materials, none of these products are stocked and all requests for quotations must be accompanied by accurate description and exact dimensions of the products desired.

EHRET'S ASBESTOS MILLBOARD

Ehret's Asbestos Millboard is made with asbestos fibres which are specially prepared and mixed with various inorganic binding materials. These ingredients are formed under pressure into dense, hard sheets of accurate dimensions which are thoroughly dried and cured at the factory. Millboard sheets are homogeneous and have no tendency to disintegrate or separate when exposed to moisture, water or temperatures within the recommendation limitations.

The color of Millboard is a light gray, bordering on white, which is attractive in appearance without painting or further finishing. Thicknesses of this material are held to close tolerances and its co-efficient of expansion is so low that temperature changes cause practically no expansion or contraction.

To answer a broad range of requirements, Ehret's Asbestos Millboard is available in several types. The standard size of all types of Millboard is 42″ x 48″, but cut sheets will be supplied on special order. Millboard is normally packed in cases, but, if desired, either full size or cut sheets can be packed in cartons. Packaging in cartons is frequently requested by jobbers who have calls for relatively small quantities of Millboard and who wish to stock the material in handy size packages.

Commercial Millboard

Ehret's Commercial Millboard is an improved material that is manufactured by a recently-developed process. The density of this new type Millboard is much lower than that of the old type material, with no sacrifice of structural strength or hardness. The workability of this lighter material is similar in practically all respects to ordinary Millboard.

Although Ehret's Commercial Millboard is normally furnished in Medium-hard grade, it can be furnished in two harder grades, namely, X-hard and XX-hard. The Medium-hard grade is used for most general needs and for work necessitating a semi-pliable material that can be bent to conform to large radius curves. The X-hard and XX-hard grades are for use where stiff, strong, self-supporting sheets are needed as in linings, partitions, etc. Unless otherwise specified, Commercial Millboard will always be furnished in the Medium-hard grade.

Designed particularly for use as a fireproof and structural material, Ehret's Commercial Millboard will withstand exposure to temperatures ranging up as high as 900° F. Although Millboard is not primarily an insulating material, it has a fair amount of insulating value when used on temperatures up to 500° F. It is exceptionally well suited as a protection against flame, heat and corrosive fumes in the industrial and architectural fields. Being moisture-resistant, Millboard is frequently used in the construction of linings for floors, ceilings, walls, partitions, radiator recesses and elevator shafts. Many equipment manufacturers apply this material as linings in stoves, ranges and grates. In the industrial field, Commercial Millboard is used as a fireproof support for insulating materials in built-up panels on air-cooled boiler walls.

Finishes

In addition to the several degrees of hardness mentioned above, Ehret's Millboard is available in two types of finish, namely Standard and Precision.

Standard Millboard has an extremely smooth finish on one side of the sheet, while the opposite side is quite smooth in character. Thickness variations in this Standard finish are held to less than 10%.

Precision Grade Millboard is made with small, pin point indentations on both sides of the sheets. This surface is very desirable in providing good bond when the sheets are to be applied to metal surfaces. Thickness variations in Precision Millboard are held to tolerances of not more than .002″. This unusually close tolerance makes this material especially well suited for use in gasket work.

In ordering Millboard the desired finish should be

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specified. If no specification is made, the Standard finish will be supplied. Thicknesses are given in the following table.

EHRET'S ASBESTOS MILLBOARD

Weights and Thicknesses based on 42" x 48" Sheet
Actual weights of standard finish may vary ±10%.

*Thickness	Approx. Wght. Per Sheet	No. of Sheets per Carton	No. of Sheets per Crate
1/16"	3½ lbs.	24	100
3/32"	5 "	16	75
1/8"	7 "	13	56
3/16"	11 "	9	38
1/4"	15 "	7	28
3/8"	22 "	4	18
1/2"	29 "	3	14
5/8"	36 "	2	11
3/4"	44 "	2	9

* Also available in thicknesses of 1/32", 3/64", 5/64", 5/32" and 5/16".

Welders Millboard contains long asbestos fibres and consequently the mechanical strength of this product is quite high. The formula used in the manufacture of this type Millboard is such as to make it suitable for use with temperatures as high as 1200° F. Even at this temperature it will not smoke, char or give off fumes of any kind. It is an exceptionally fine material for use by welders in connection with their work as it will retain its strength at high temperature ranges. Glass sign manufacturers frequently use this material as also do the manufacturers of arc reflectors, fire screens and hot plates.

Welders Millboard is available in sheets 42" x 48", in thicknesses of 3/16" and 1/4".

Gasket Millboard contains the longest obtainable asbestos fibre and is suitable for use where the highest quality Millboard is desired.

Gasket Millboard is suitable for use with temperatures up to 1000° F., and it is largely used in the fabrication of gaskets for hot oil, gas and tar lines, oil stills, etc. Manufacturers of brake lining products also use it for clutch facings and for such uses it is ideal, each sheet being pressed with such care as to ensure exact uniformity of both density and thickness. The special slow drying process which is used in the manufacture of this Millboard ensures against shrinkage. Ehret's Gasket Millboard is finished on both sides with a semi-rough embossing which provides good adherence qualities in gaskets made of this material.

Gasket Millboard is available in sheets 42" x 48", in thicknesses of 3/32", 1/8", 3/16" and 1/4".

EHRET'S ASBESTOS PYROBOARD . . .

Similar in general character to Millboard, Ehret's Asbestos Pyroboard contains portland cement in sufficient quantity to give this product greater strength and fire resistance. The amount of portland cement used is carefully calculated to provide maximum strength, hardness and durability. Since Pyroboard contains no organic binders or fibres, it is water and vermin-proof and does not mould, decay or disintegrate.

The uses of Ehret's Asbestos Pyroboard are numerous in the building, industrial and manufacturing fields. It is used for walls, ceilings, partitions, ventilators, hoods and baffles. In the construction of kilns, ovens, air-cooled boiler walls and other such equipment it has wide adaptability. Manufacturers of furniture and electrical equipment use Pyroboard for laboratory and kitchen table tops, sanitary linings, core oven plates, etc. Pyroboard may be worked, nailed, drilled and sawed in any direction.

In addition to being unaffected by moisture, steam or complete submersion in water, Pyroboard will withstand temperatures well above the requirements for residential, public buildings and general industrial plant fireproofing.

Ehret's Asbestos Pyroboard is a pleasing light gray in color and does not require painting. If desired, however, these sheets can be sized and finished.

The surfaces of Pyroboard are quite smooth and thickness uniformity is held within tolerances of ±.016" on sheets of 3/8" and less in thickness, and ±.032" on sheets greater than 3/8" thick. On special order Pyroboard can be furnished with one or both surfaces sanded smooth to accurate, uniform thickness.

The standard sizes of Pyroboard sheets are 36" x 48", 42" x 48" and 42" x 96". Thicknesses are shown in the following table. Standard sheets will be cut into smaller sizes at the factory if desired, with a dimensional tolerance of ±1/32".

PYROBOARD WEIGHTS

Approximate, in pounds per square foot

*Thickness	Weight, Crated	Weight, Uncrated
1/8"	1.3	1.2
3/16"	2.0	1.8
1/4"	2.6	2.4
5/16"	3.4	3.1
3/8"	4.0	3.6
1/2"	5.3	4.8
5/8"	6.8	6.2
3/4"	7.9	7.2
7/8"	9.2	8.4

* Thicknesses of 1" up to and including 4" are also available.

EHRET'S ASBESTOS SAFETY CLOTHING . . .

Many modern industrial activities require the use of fireproof safety clothing. Rolling mills, glass works, foundries, oil refineries and enameling plants are but a few of the numerous industries that are large users of protective clothing. Welders, workmen who handle hot objects, and a host of others whose occupations expose them to the hazards of heat, sparks or fire, need the protection afforded by asbestos safety clothing.

In addition to being fireproof, Ehret's Asbestos Safety Clothing is designed for comfort and long wear. A large variety of safety clothing products are carried in stock and special items will be designed and manufactured to customer specifications.

All asbestos clothing as here listed will be furnished in Commercial grade asbestos unless otherwise specified.

Aprons—made of various weights of asbestos cloth, are available in both Standard Bib style and Welders Slit style in 24″ width and various lengths.

Coats—made of asbestos cloth are available, in chest size as specified, in standard lengths of 30″, 32″, 40″, 44″ or 52″.

Coat and apron combinations of various types are also available.

Finger stalls or cots—are available in small, medium and large sizes, with or without tie-bands.

Gloves and mittens—can be furnished in a wide variety of sizes and styles, in both Standard and Enamelers types, in 11″, 14″, 18″ and 23″ lengths.

Standard types are available, lined or unlined, plain or reinforced with asbestos or leather. Enamelers mittens can be furnished in metallic or plain asbestos cloth with or without palm patches.

Hand pads—made of asbestos and reinforced with leather are available in small, medium or large sizes.

Hats—of the sou'wester style are made in two types, regular and stiff crown.

Hemlets—are furnished with long or short capes and various types of glass lenses, as specified.

Hoods—are available with stiff crown, cape in front and a Monel metal screen.

Leggings—are made in a variety of standard types including Knee length, Hip length and Slip-over style.

Overalls—with bib, in a full range of sizes.

Overshoes—are available in shoe, calf and knee height. (8″, 12″ and 16″).

Safety clothing protects this welder from the hazards of his job.

Pants—are available in any specified length and waist measurement, in either Regular style or Bell-bottom style.

Sleeves—also known as arm protectors, are available in 12″, 18″ or 24″ standard lengths, in unlined style as well as fleece, duck or wool lined.

Spats—for protecting the foot and ankle, are furnished in specified sizes.

Suits—are available in several styles in a full range of sizes. One-piece jumper suits, two-piece suits, consisting of separately ordered coat and pants, as well as complete fire-fighting uniforms, consisting of a helmet with mica eye-shield and long cape, one-piece jumper suit, 12″ overshoes and 14″ gloves. This complete fire-fighting uniform will be furnished in special kit where desired.

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EHRET'S ASBESTOS BLANKETS AND CURTAINS

Made from various types of asbestos cloth, Ehret's asbestos blankets and curtains find wide application in the industrial and architectural fields.

Welding Blankets

These blankets are used by welders to cover preheated metal objects during the process of welding. Their use retards the escape of heat for slow cooling or annealing after welding.

Several standard types of welding blankets are available. Single-layer, double-layer and double-layer-filled blankets are made, in a number of sizes, of various weights of asbestos cloth. The filled-blankets contain long, brown amosite fibres between the layers, and consequently this style of blanket has excellent heat-retaining characteristics.

Welding blankets are normally furnished in AAA grade asbestos cloth, and the sewed types are stitched with asbestos thread.

Smothering Blankets

Used principally in conjunction with fire-fighting apparatus, smothering blankets are normally used for extinguishing small fires. They are frequently placed in oil refineries, gasoline service stations, dry cleaning establishments, engine rooms and similar locations where workmen's clothing or other combustible materials are subject to fire hazards. Available in standard sizes of 71″ x 71″, 75″ x 75″ and 79″ x 79″, other sizes will be furnished on order.

Fire Protection Blankets and Curtains

Many industrial operations require the use of fire protection blankets. They are commonly used in temporary locations to protect workmen or materials from radiated heat, welding sparks and similar hazards. These blankets are also used, for general fire protection purposes, by the fire departments of oil refineries. Fire protection blankets are made, on specification, in any size desired. Brass grommets, tie ropes or rope handles can be attached if desired.

Asbestos cloth curtains are frequently used in industry for protection against heat, sparks or fire. Steel mills, electric sub-stations, glass works and warehouses are but a few of the many users of this type of protection. These curtains are made to specified sizes, of either plain or metallic cloth.

Theatres, auditoriums, convention halls and similar places of public meeting are usually required, by law, to be equipped with fireproof curtains. Plain or metallic asbestos cloth curtains for this type of service will be manufactured to specifications.

EHRET'S ASBESTOS WICK AND ROPE . . .

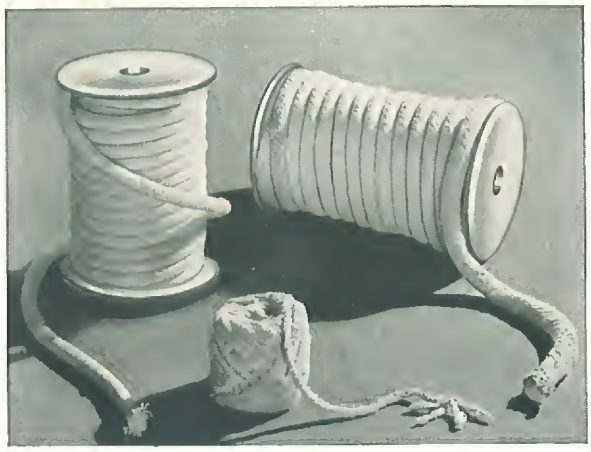
Construction and expansion joints of various kinds necessitate the use of a soft, resilient, fireproof packing material. Ehret's Asbestos Wick and Rope are especially suited for such needs. Construction joints are common in panel-type insulations and expansion joints are frequently required in brick and cement construction such as furnace walls, floors and roofs, combustion chambers, ovens, breechings and similar high temperature equipment.

Ehret's Asbestos Wick is produced by twisting strands of asbestos roving into a soft, flexible, rope-like material that can be used as supplied, or separated into strands. Ehret's Asbestos Rope is similar to the wick, except the center strands of asbestos are bonded together with a suitable compound and the resulting product is firmer and more durable than the wick.

The basic material used in the manufacture of both the wick and rope is asbestos fibre. Various grades are available and the asbestos content of these grades are as follows:

Grade Name	Approximate Asbestos Content
Commercial	80%
Underwriters	85%
AA	90–92%
AAA	95–96%
AAAA	100%

On temperatures up to 400° F. the Commercial Grade is thoroughly satisfactory, but for higher temperatures the better Grades should be used. Commercial Grade is always furnished unless otherwise specified.



Ehret's Asbestos Wick and Rope are available in the sizes listed below. The wick is furnished in continuous lengths, in ¼, ½ and 1-pound balls and on wooden reels of 25 or 50 pounds net. The rope is furnished on reels of 25 or 50 pounds net.

EHRET'S ASBESTOS WICK

Diameter	Approximate number of lineal ft. per lb.	
	Commercial Grade	AA Grade
¼″	56	50½
⅜″	29	26

EHRET'S ASBESTOS ROPE

Approximate Number of Lineal Feet Per Pound

Grade Name	Diameter of Rope								
	⅜″	½″	⅝″	¾″	⅞″	1″	1¼″	1½″	2″
Commercial Grade	20	15	7	5½	4½	3½	2¾	2¼	1¾
AA Grade	18	13½	6¼	5	4	3	2¼	2	1½

EHRET'S ASBESTOS BOILER WALL COATING . . .

When masonry boiler walls are not to be covered with insulation, it is generally desirable to coat the outer surfaces to prevent air from leaking through joints, cracks or pores into the combustion chamber. Such infiltration normally takes place to a surprisingly great degree on unprotected boiler walls. It is not uncommon to find fuel losses ranging as high as 20% attributable to this cause.

An inexpensive and effective means of guarding against boiler wall air leakage is to cover the brickwork with Ehret's Asbestos Boiler Wall Coating. This material is made from a base of Trinidad asphalt and it contains a large proportion of asbestos fibres. It comes ready-mixed to a putty-like consistency that is readily handled and applied with a trowel.

In applying Ehret's Asbestos Boiler Wall Coating it is usually best to apply a thin trowelled coat to fill holes and seal the surface. After this first coat has been permitted to dry for 5 or 6 hours, the final coat may then be applied to a total thickness of 3/16″ to 1/4″ and trowelled smooth. After the material has dried from 24 to 36 hours, it can, if desired, be smoothed even more by dipping a steel trowel into kerosene and then rubbing it over the surface. After the coating is thoroughly dry it can be painted with aluminum paint to provide an attractive finish.

The covering capacity of Ehret's Asbestos Boiler Wall Coating will depend upon the character of the surface to be covered. In most cases, however, it will require about 10 to 12 gallons per hundred square feet. Furnished in 1, 5, 10 and 55-gallon containers, this material weighs approximately 10 lbs. per gallon.

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EHRET'S ASBESTOS FURNACE CEMENT

Ehret's Asbestos Furnace Cement contains long asbestos fibres and various carefully prepared and accurately proportioned refractory and binding ingredients. It is mixed into smooth paste form that is easily handled with trowel or spatula and when thinned, it can be applied with a stiff brush. Although usually used as supplied in the container, it mixes readily with water to any desired consistency.

This furnace cement is completely free from lumps and gritty substances, and will air-set in a few hours. It can be applied to hot or cold metals and will withstand high service temperatures without cracking, crumbling or blistering. It does not shrink or deteriorate with age and the dry cement closely matches cast iron in appearance.

Extremely easy to apply, Ehret's Asbestos Furnace Cement is widely used for setting up joints in new equipment and for repairing broken joints or cracks in furnaces, ranges, heaters, stoves and boilers. It is an excellent material for sealing openings that develop around fire and boiler tube doors. It is also used for sealing holes in flues and breechings and cracks in cast iron doors. Its use prevents smoke, gas, dust and soot from escaping, stops air infiltration and assures better draft. Those who install domestic oil burners find it excellent material with which to seal clean-out doors, dampers, flue pipes and other furnace parts, as well as for bonding tile onto the periphery and sealing cement onto the hearth pan of rotary burners.

In applying asbestos furnace cement to metal surfaces, the metal should be thoroughly cleaned of loose paint, rust, soot, grease and other foreign matter before the cement is applied. On new equipment it is sometimes desirable to apply the cement in a diluted form, about the consistency of paint, to the entire metal surface of the joint. This can be done with a brush or wet cloth, and it fills the pores of the metal and slight surface defects which are usually found in castings. The undiluted furnace cement should then be applied with a spatula or putty knife in the usual manner and the cement pressed firmly against the metal. After air-setting the cement will form a hard, permanent, gas-tight bond which will stand up under expansion and contraction stresses.

As it does not harden or deteriorate in the container, Ehret's Asbestos Furnace Cement may be stored indefinitely, but care should be taken to keep the lid tight on partially used containers to prevent hardening. The following table gives the sizes and weights of the standard containers of Ehret's Asbestos Furnace Cement.

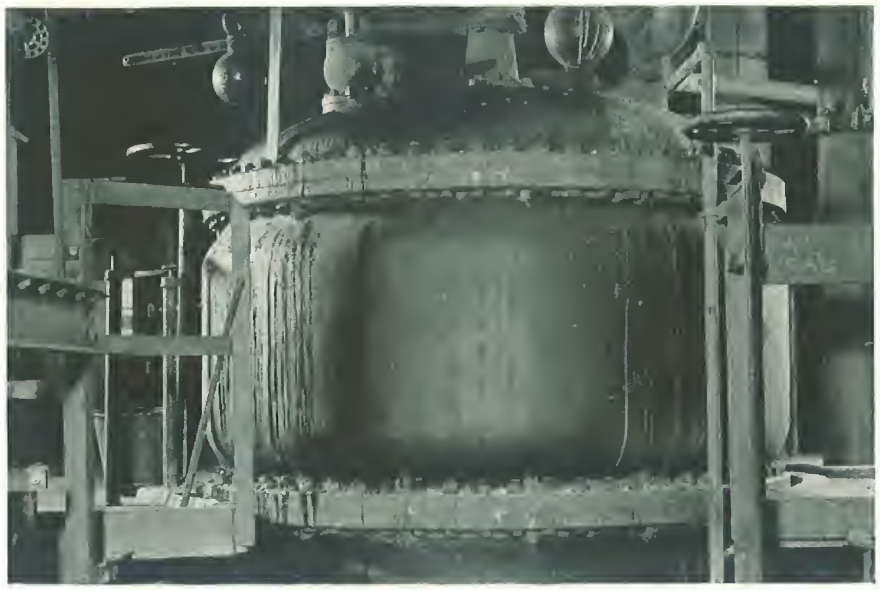
Weight of Contents	Type of Container	Cans per Carton	Gross weight in Pounds
1 lb.	Can	50	65
2 lb.	Can	25	63
3 lb.	Can	18	64
5 lb.	Can	12	67
10 lb.	Can	6	68
25 lb.	Pails	..	27
50 lb.	Pails	..	54
100 lb.	Drums	..	105
250 lb.	Drums	..	270
500 lb.	Drums	..	530
750 lb.	Drums	..	800

EHRET'S ASBESTOS LEAD JOINT RUNNERS

Specially designed for pouring lead joints in cast iron and other types of bell-and-spigot pipes, Ehret's Asbestos Lead Joint Runners combine quick, easy attachment with long service life. They are made of commercial grade asbestos fibres, tightly braided over a firmly twisted core, and formed into a square cross-sectional shape.

All Ehret's Asbestos Lead Joint Runners are furnished complete with aluminum ferrules on the ends and a quickly-adjustable clamp that is attached by means of a sturdy chain.

Style No.	For Size of Pipe	Size of Runner	Approx. Wt. (each)	No. Per Carton
1	2″, 3″, 4″	¾″ sq. x 2′ 0″	⅝ lb.	6
2	4″, 5″, 6″	¾″ sq. x 2′ 6″	¾ lb.	6
3	6″, 8″, 10″	1″ sq. x 3′ 6″	1¾ lbs.	6
4	10″, 12″, 14″	1″ sq. x 4′ 10″	2¼ lbs.	6
5	16″, 18″, 20″	1¼″ sq. x 6′ 9″	4⅜ lbs.	3
6	24″	1¼″ sq. x 7′ 10″	5 lbs.	3
7	30″	1¼″ sq. x 9′ 4″	5⅞ lbs.	3
8	36″	1¼″ sq. x 11′ 3″	7 lbs.	1
9	42″	1¼″ sq. x 13′ 0″	8 lbs.	1
10	48″	1¼″ sq. x 14′ 7″	8¾ lbs.	1



This converter is insulated with Ehret's 85% Magnesia Block and Ehret's Fibrekote protects the insulation from damage by overflow. Hot water is applied with a hose to clean the surface.

EHRET'S FIBREKOTE

Ehret's Fibrekote is a specially prepared plastic material that is used for protecting surfaces from exposure to moisture or weather. When applied over insulating materials, Fibrekote ensures against loss of insulating efficiency by protecting the insulation from the damaging effects of moisture or chemical fumes. Since this plastic material is applied in a continuous film, air infiltration is prevented and the tough, leatherlike character of the dried Fibrekote also offers considerable protection against abrasion and mechanical abuse.

Fibrekote is highly practical and satisfactory for use on the insulation of exposed pipe lines, breechings, ducts, boilers, cookers, tanks, stills, retorts, digestors and a wide variety of process equipment. It is also used to protect uninsulated surfaces such as tanks, roofs and tank cars. Under conditions of even severe weather exposure, it will last for many years. When necessary, additional applications of Fibrekote can be made directly over badly-weathered surfaces.

The materials used in the manufacture of Ehret's Fibrekote are a special type of asphalt emulsion and the best grades of long asbestos fibres. The emulsion has a clay content that is so prepared and mixed that it will not separate or form lumps. The high asbestos content in Ehret's Fibrekote gives the resulting product fire-resisting characteristics. When applied and dried, open flame can be directed on Fibrekote for short periods of time with no damage to the material.

Application

Before applying, Fibrekote should be thoroughly stirred and mixed in the container and the surfaces to be covered should be made clean and dry. The Fibrekote can be trowelled directly onto the surface and it should be applied in one or more layers ¼" thick. Drying of the Fibrekote will reduce the thickness from ¼" down to ⅛", and this causes the Fibrekote to become tough and leathery in character. This shrinking is highly desirable because it closes the pores in the spongy, wet material and results in a smooth, impervious surface.

The covering capacity of Fibrekote is approximately 45 square feet, ¼" thick (wet) per hundred pounds. When set and dried, its natural color is a dark gray, and if desired, it can be painted. Aluminum paint is frequently used as a final finish on Fibrekote.

Two grades of Fibrekote are available, the Regular Grade which is thoroughly satisfactory for use under normal application conditions, and a special Winter Grade for use when application must be made while temperatures are below 45° F. Unless otherwise specified, the Regular Grade will be furnished.

Packaging

Ehret's Fibrekote is furnished in metal drums of 50, 100, 300 and 500 pounds net weight.

FIBREKOTE PRIMER

When Fibrekote is to be applied on Cork or metal surfaces, Fibrekote Primer should be used to ensure good bond. This Primer is easily applied with a brush or trowel and it will dry in 4 to 6 hours at normal room temperatures. During the drying process, the color of the Primer changes from a brown to a black, and after this color change has taken place the Fibrekote may be trowelled directly onto the primed surface.

Priming will require from 1 to 1½ gallons of material per 100 square feet, depending upon the character of the surface to be covered. Fibrekote Primer weighs approximately 10 pounds per gallon and is furnished in metal containers.

WATERPROOFING MEMBRANE

When metal surfaces are to be protected with Fibrekote, it is highly advisable, for purposes of ensuring a permanent bond, to use Ehret's Water-

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Proofing Membrane as a foundation for the Fibrekote. This specially-treated saturated cotton fabric is woven 40 threads to the inch and meets ASTM specifications. It tears and cuts readily for application.

The method of using this Membrane to bond Fibrekote to metal surfaces is as follows: Apply a coat of Fibrekote Primer to the metal, and before the Primer is completely dry, smoothly wrap the surface with the Membrane. The Primer will act as as an adhesive to hold the Membrane in place, and as soon as it has dried, apply a coat of Primer over the Membrane. When this second coat of Primer is dry, the Fibrekote can be applied in the usual manner.

Ehret's Waterproofing Membrane is available in full rolls one yard wide by 50 yards long and also in cut lengths.

EHRET'S INSULATION WEATHERPROOFING FELTS . . .

It is sometimes desirable to protect the insulation on existing piping or equipment from moisture by means of a wrapped-method of weatherproofing. The following materials will answer practically all requirements for this type of protection.

JACKETS (Applied on the Job)

These jacket materials are finished roofing products and are well suited for pipe insulation protection. They are normally furnished in standard size rolls which are readily cut to size on the job. On special order the rolls can be cut at the factory to specified sizes.

Parabestos Roofing

This material is made with a rag felt base that is thoroughly saturated and coated with weatherproofing asphalt. Both sides are finished smooth and then coated with powdered talc. Standard rolls, 36″ wide and 36′ long, can be supplied in weights of approximately 35, 45, and 55 lbs. per roll. This material will, with proper maintenance, give reasonable service on outdoor lines against normal weathering conditions.

Minkote Asbestos Roofing

This material is made with an asbestos felt base that is impregnated and coated on both sides with weatherproofing asphalt. Both surfaces of Minkote are finished with mica. Standard rolls are 36″ and 32″ wide and weigh approximately 50 lbs. per roll. This product should be used where outdoor pipe lines are exposed to fire hazards, acid or chemical fumes, as the asbestos base and the inorganic surface resist fire and chemical action.

INTEGRAL JACKETS (Factory attached)

Some specifications require the weatherproofing jackets to be attached to sectional pipe insulations at the factory, so that the insulation and the weatherproofing can be applied at the same time. Integral jackets are fabricated from 3 plies of 15-lb. asphalt saturated asbestos felt and are firmly cemented to each section of pipe insulation before shipment is made.

FINISHING

Jackets that are cut on the job should be applied with laps of approximately 3″ at all seams. Horizontal laps should always be located so as to shed water and they should be tightly sealed with Ehret's Sealing Compound or Lap Cement.

Factory-cut and integral jackets are so made as to have laps of the proper width at the side seams. The factory-cut jackets should be lapped approximately 3″ at all circumferential seams. Integral jackets are cut flush with the ends of the pipe coverings and strips of the proper width are furnished for wrapping and sealing over the circumferential joints. These strips should be applied with their side laps on the opposite side from the jacket laps.

Weatherproofing jackets should, as soon as the laps are sealed, be wired-on with separate loops of No. 16 gauge copper or Copperweld wire, spaced not more than 6″ apart. The ends of the wire loops should be firmly twisted together with pliers and bent close against the surface of the weatherproofing, care being taken so as not to puncture the jacket.

WEATHERPROOFING COMPOUNDS

The quality of the material used to seal the laps of weatherproofing jackets is highly important because all joints must stay tightly sealed to prevent the entrance of moisture. Both of the following products are asphaltic materials and can be applied with a brush. The covers on partially used containers should be kept tight to prevent hardening.

Ehret's Sealing Compound

This quality cement is made from cut-back asphalt and has excellent adhesive qualities. It dries to a sticky surface almost immediately upon application, so that the jackets will hold when pressed into place. This material is also used to coat the entire surface of the jacket when such additional protection is deemed necessary. It is available in 1, 5, 10, 50, 300 and 550-lb. containers.

Ehret's Lap Cement

This is a standard grade asphalt compound like that usually furnished as an accessory with prepared roll roofings. It is available in ½, 1, 5, 25 and 50-gallon containers.

EHRET'S FIBROUS ADHESIVE . . .

When insulating blocks, lagging or segmental coverings are to be applied to metal or masonry surfaces, the use of the proper adhesive will expedite the application and result in a tighter, sturdier, finished job. Ehret's Fibrous Adhesive is a plastic material that has been compounded especially for this purpose.

In addition to being used to hold insulations on the surface to be covered, Ehret's Fibrous Adhesive is also used to bind the layers of multiple layer insulation. Such use results in an application that is much less likely to permit air leakage or infiltration and the blocks are bonded into a solid, sturdy structure. Temporary bindings during application are not required as blocks or segments of insulation need only to be "spotted" with adhesive and pressed into place.

Surfaces on which Ehret's Fibrous Adhesive can be used include metal, brick and concrete. This adhesive will hold on practically any dry, clean surface that is free from grease or paint. No under coating, sizing or special preparation of the surface is required.

In using Ehret's Fibrous Adhesive it should be applied to the insulation and not to the surface to be covered. The adhesive need not be spread completely over the block as "spottings" on the block will suffice. The character of the surface to be covered will govern the amount of Fibrous Adhesive required. Naturally, the rougher and more porous surfaces will require a more generous use of the adhesive. The following information will serve as a guide in estimating the amount of adhesive required.

(1) For applying insulation to metal surfaces, 50 lbs. of adhesive will serve for approximately 100 square feet of surface.

(2) For applying insulation to brick or concrete and between insulation layers, 75 lbs. of adhesive will serve for approximately 100 square feet of surface.

Ehret's Fibrous Adhesive is furnished, in drums of 100 lbs. net weight. It should be thoroughly stirred in the container before use.

SEWING AND PASTING JACKETS . . .

Canvas Jackets

Enameling duck, also known as No. 105 double filled canvas, is widely used for sewed jackets on pipe coverings and other insulated surfaces where a smooth painted finish is to be applied. It can be stretched and sewed with a minimum of wrinkling and the material is treated with a primer to provide a good base for painting after application. Commonly furnished in rolls 72" wide, this material weighs approximately 8 ounces per square yard.

For sewed jackets that are not to be painted or where it is desired that the jackets be primed after they have been applied, a good grade of cotton canvas of the desired weight is generally used. This cotton sewing canvas is available in weights of 8, 10 and 12 ounces per square yard.

Cotton twine of the proper strength for sewing enameling duck and canvas jackets is available in balls. This twine is normally furnished unwaxed, but can be furnished in pre-waxed form if desired.

Needles and palms for sewing canvas jackets are available in unit quantities.

Canvas for pasting over segmental pipe coverings, block insulations and cement finishes is available in a variety of weights. A 2-ounce drill is the lightest material in common use and pasting canvas of 4, 5, 6 and 7-ounce weights is available in standard rolls.

Asbestos Cloth Jackets

On high temperature work it is frequently required that sewed jackets be fireproof. This is often the case on diesel exhaust headers and similar equipment. A standard asbestos cloth for this service is made from commercial grade two ply 10 cut yarn and the cloth weighs approximately 2¼ lbs. per square yard. There is no wire insertion in this material and it can be cut, applied and sewed in the same manner as canvas jackets, except that it should be stretched over asbestos paper instead of rosin-sized paper and asbestos twine should be used for sewing instead of cotton twine. Special grades and various weights of asbestos cloth can be furnished on request. Rolls are available in 40" width, weighing approximately 25 and 50 lbs. each.

Asbestos twine suitable for sewing asbestos jackets is available in balls.

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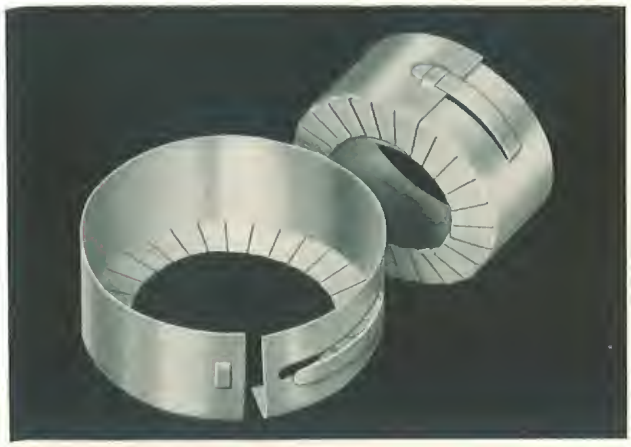

PIPE COVERING PROTECTORS

When 85% Magnesia, Air Cell and similar pipe coverings are applied in such a manner as to leave the ends of the coverings visible, Pipe Covering Protectors may well be used to provide a neat finish and to prevent damage to the ends of the insulating material.

Pipe Covering Protectors are designed to fit over the end corners of the coverings. They are made of 20-gauge aluminum and are available in sizes to fit coverings on pipes up to 8" nominal size. Protectors are adjustable to a total circumferential variation of 1½" and are easily and quickly installed by locking from the outside with a simple tongue clasp.

Unless otherwise ordered, Pipe Covering Protectors are furnished in the natural-finish aluminum. Special finishes, including black, polished aluminum and any specified color are available on order. Always specify size and thickness of coverings on which Pipe Covering Protectors are to be used.

BANDS

Steel Bands

Steel bands are available in black lacquered and gold lacquered finish. They are commonly used on pasted-and-banded pipe covering applications. Bands are made in standard widths of ¾", 1" and 1¼" and any desired length.

Solid Brass Bands

These bands are frequently specified on government work and for use in locations that are subject to conditions of excessive moisture. Made from 30-gauge brass and available in sizes as desired.

Special Bands and Straps

Other bands are available for use under various conditions. Included are galvanized steel bands, solid zinc bands, solid bronze bands and Signode straps. The bands are usually applied with clips and a special instrument similar to that used for applying steel for box strapping. These special bands are sometimes used for fastening large-sized segmental coverings in place, and Signode straps are specially designed for holding block insulation on large tanks and similar surfaces.

WIRE AND CABLE

Full range of sizes of annealed iron, copper and Copperweld wire are available for use in applying various types of insulations and weatherproofing jackets. In ordering, the type as well as the gauge of wire desired should be specified.

Steel cable of approximately ⅛" diameter for securing block insulations is available in rolls.

ROSIN-SIZED PAPER

This material is used as an under-wrapping for sewed canvas jackets to provide a smooth surface and prevent wires from coming in contact with the sewed jacket. Available in rolls 36" wide, containing approximately 500 square feet of paper, in base weights of 30 and 40 lbs.

PASTE

Two grades of paste are available for use in applying pasted jackets to insulations. Cold water paste is prepared from organic materials and is treated to make it vermin-proof. Furnished in dry powder form, it needs only to be mixed with cold water to the proper consistency.

Silicate of soda paste is also available and is frequently used because of its moisture-proof characteristics. This material is furnished in liquid form, in metal containers.

MISCELLANEOUS MATERIALS

A large variety of miscellaneous products is available for use in applying and protecting insulations. Included in this group of accessories are:

Clips—to be fastened onto metal surfaces for the attachment of cables and wires.

Staples—for holding and strengthening the application of pipe coverings, blocks and jackets.

Metal Lath—for use in forming air spaces between heated surfaces and insulations. A variety of styles and rib structures are obtainable in standard-sized sheets.

Wire Netting—in mesh sizes from ½" upwards in hexagonal and other forms. The smaller sizes of netting are frequently used in construction of removable flange covers. The larger sizes are used for reinforcing cement finishes, holding block insulations in place, bond for the application of waterproofing finishes and similar purposes.

EHRET

DURANT SYSTEM

PRE-SEALED INSULATED PIPE

and

PRE-SEALED PIPE LINE PROTECTION

INSULATION MANUAL

SECTION 5

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. DP 300

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The Durant Insulated Pipe that is being installed under this railroad right-of-way is close under the ties. Impact of passing trains cannot injure the insulation or waterproof protection in any way.

EHRET'S DURANT INSULATED PIPE

. . . FOR USE IN UNDERGROUND AND EXPOSED LOCATIONS

Some outstanding advantages of DURANT INSULATED PIPE.

1. **Permanently waterproof.**
2. **Elimination of electrolysis and corrosion.**
3. **Requires no sub-drains as even complete water submersion does no harm.**
4. **In multiple lines, individual Durant pipes can be added, removed or replaced without disturbing others.**
5. **Minimum trenching and field work.**
6. **No rollers or pipe supports required.**
7. **No breakage or waste of material during installation.**
8. **Tile or masonry protection not required.**
9. **Field costs are much lower than those of tile, tunnel and similar systems.**
10. **Insulation protection is absolutely dependable.**

Pipes carrying steam, hot water, cold water or refrigeration are often required in underground or weather-exposed locations. In such cases the insulated piping needs to be protected from moisture and other service hazards.

Up until recent years, the most important methods of protecting such insulated piping included built-up membrane-type weatherproofing, mopped-on asphalt, jackets and, on underground work, tile and concrete ducts, tunnels and housings. Such methods are, generally speaking, but semi-permanent in character.

Weather-exposed protection of the membrane or jacket-type requires frequent inspection, maintenance and repairs, while tile, masonry and similar underground protective systems are subject to failure from any one of a number of causes. Careless backfill or settling of the ground frequently results in cracking or complete failure, and heavy impact of nearby trucks or trains often causes damage that necessitates costly repairs. Unnoticed seepage of underground water into supposedly good masonry or tile systems can cause power losses of major importance, and in many cases, such losses continue for years without giving evidence of their existence. It was during an ex-

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EHRET
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tensive search for a *dependable* method of protecting insulation on underground piping that Ehret's Durant Insulated Pipe was developed. Thousands of feet of Durant System piping with a record of years of *maintenance-free* service have amply proven the ability of this system to maintain insulation efficiency under even the most severe conditions.

Construction of Durant Insulated Pipe

In the Durant System, pipe of the specified sizes, in full or cut lengths, is both insulated and protected in our factory. The workmen who apply the insulations in the manufacture of D. I. P. are highly skilled. The conditions and factory supervision under which all of the work is done ensure uniformly excellent workmanship, which is seldom the case in the field application of insulations to underground piping.

The insulation used in the manufacture of D. I. P. is Ehret's 85% Magnesia. This highly efficient and dependable insulation is particularly well suited for use on hot or cold services in Durant Pipe, and the thickness of the insulation is governed by the service temperature requirements.

For pipes above 2" in diameter, supports are porvided within the D. I. P. structure to prevent the weight of the pipe from resting on the insulation. These supports, called Calag Blocks, are inserted through the insulation during the fabrication of D. I. P., and they transmit the weight of the pipe directly to the outside of the D. I. P.

After the covering and Calag Block supports have been fitted to the pipe, all joints are taped and sealed. A cylindrical jacket of heavy galvanized steel with a diameter large enough to provide a 1" (or ½") air-space outside of the insulation, is placed concentrically around the insulated pipe. This metal jacket has small openings at regular intervals along the top and the Calag Blocks are located at the bottom. The insulated pipe is then ready to receive the asphalt protection.

The protection for the insulation consists of a special grade of high-melting-point asphalt which is heated to the proper temperature and poured through the openings in the top of the metal jacket. The space between the insulation and the metal jacket is completely filled. Cooling hardens the asphalt into a time-defying layer that is permanently moistureproof and water tight, which will resist acids, alkalies, mechanical shocks of handling, ground pressure and similar hazards.

The metal jacket on the outside of the asphalt is left permanently in place and during shipping and handling it provides an additional guard against mechanical damage. On exposed pipe lines the metal jacket can be painted to provide a permanently attractive finish.

For installation purposes, sufficient bare pipe is left exposed at the ends of D. I. P. pipe lengths to permit making field connections. The pipe ends can be furnished either threaded or chamfered for welding. The Durant System of piping is now ready to be shipped to the destination.

Installation of D.I.P.

Since the insulation and protection are factory-applied to D.I.P., field operations are limited to placing the pipe lengths into position, connecting and then insulating and sealing the joints. In underground pipe systems, backfill can be made at once and, if desired, can be flooded with water to pack it. The system is completely waterproof as soon as the joints have been finished.

Durant Insulated Pipe is made with a ½" thick as well as a 1" thick asphalt layer. The lighter protection is perfectly adequate for service in normal outdoor exposure, but the 1" thickness should always be specified for underground work.

Foundations are practically never required for underground D. I. P. installations. The pipe needs merely to be placed on the bottom of the graded trench. Only comparatively narrow trenches are required and the individual lengths of D. I. P. can be readily lowered into the trench with rope slings. In the trench the pipe can be turned and slid into proper position and the exposed pipe ends provide plenty of clearance for workmen to connect and finish the joints.

The Durant System treatment can be effectively applied to elbows, special fittings and equipment. Short pipe lengths, expansion bends and joints, as well as curved and special piping, can be factory-protected with the Durant System and shipped to the job, ready for installation.

OTHER DURANT SYSTEM PRODUCTS

The Durant System of protection is also applied to un-insulated piping. The heavy asphalt layer is factory-poured between the metal jacket and the pipe itself. This product, called Durant Pre-Sealed Pipe, is well suited for use in underground service and where conditions of exposure are severe.

The permanent protection on Durant Pre-Sealed Piping prevents electrolysis and corrosion. This product is ideal for use in soils that are strongly acid or alkaline in character. On outdoor pipe lines it is unaffected by conditions of severe weathering or chemical fumes.

The Durant System of factory-applied asphalt protection is also available on insulated or un-insulated ducts. A broad range of applications of the Durant System is available in this field, particularly for the air-conditioning industry.

Easy Field Joint Method for Durant Insulated Pipe

1 **Pipe ends can be joined with threaded or welded fittings, or butt-welded as shown above.**

2 **The finished pipe joint is next covered with 85% Magnesia pipe insulation—snugly fitted in place.**

Cross section of typical D. I. P. shows simple, rugged design.

3 **The sheet metal pouring jacket is wired on over the joint—with the pouring slot located at the top.**

4 **Special Durant asphalt is melted and poured into the jacket. This quickly hardens into a perfect, permanent seal.**

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SUGGESTIONS FOR HANDLING AND INSTALLING EHRET'S DURANT INSULATED PIPE

There is nothing fragile or complicated about Durant Insulated Pipe. Since the insulated pipe is protected with a thick asphalt layer which, in turn, is covered with a sturdy metal jacket, there is little likelihood of damage to D. I. P. if reasonable care is exercised in handling and installing.

Durant Insulated Pipe can be best handled with ropes. In attaching ropes to a pipe section, ¾ or 1-inch line should be used, with a double half-hitch slipped over the pipe end that extends beyond the insulation protection. The two rope ends permit workmen to lift, raise, lower or roll the pipe without difficulty or damage. Hand lines may be fastened to both ends of a pipe length and additional lines can be used around the jacket, if desired, for lifting, carrying or lowering into a trench.

Where the ground is smooth enough to permit, D. I. P. can be rolled. Wood or metal rollers are frequently used to move the pipe sections longitudinally or diagonally. Rollers or skids are not normally required on the smaller sizes of pipe, but their use is sometimes advantageous in handling the larger sizes.

After sections of D. I. P. have been placed alongside a trench in which they are to be laid, two or more rope slings can be used to lower the pipe into the excavation. The rope ends that come from under the nearest side of the pipe should be anchored, the pipe rolled over the lip of the trench and the other ends of the slings slacked off to lower the pipe to the trench bottom. If the pipe lengths are to be moved longitudinally after they have been lowered into the trench, the slings can be used by workmen standing on the ground level.

Two 3" steam lines of Durant Insulated Pipe, located one above the other

After pipe lengths are in position on the trench bottom, they should be blocked to prevent rolling. The asphalt vents that are located along one side of the pipe should always be placed at the top, as the Calag Block supports (in pipe sizes larger than 2 inches) are located diametrically opposite to the line of these vents.

In turning the D. I. P. in the trench to place the asphalt slots at the top, a length of chain or rope may be doubled and the loop-end passed around the pipe several times with the loop located near the top. A pick-axe handle or short piece of pipe can be placed through the loop as a lever and the D. I. P. casing rotated to the desired position. Pipe wrenches or chain tongs should not be used for this turning operation as they would tend to bind the 85% Magnesia against the pipe.

Lengths of D. I. P. that have been joined together in the trench can be turned within the 85% Magnesia insulation. This is sometimes done, especially for welded joints, to facilitate the work of making the joints. Pipe wrenches or tongs can be used directly on the exposed pipe joints before they are insulated and sealed.

The handling and installation of D. I. P. is, compared to other underground systems, simple and easy. The materials are sturdy and construction methods are practical. No special tools or equipment are required and ordinary workmen can install D. I. P. with a minimum of time, trouble and expense.

DURANT INSULATED PIPE
TEMPERATURE RECOMMENDATIONS
for Various Thicknesses of 85% Magnesia Insulation

Service Temperatures	Insulation Thicknesses	Nominal Pipe Size
Up to 212° F.	Standard	All sizes
213° to 240°	1½"	All sizes
241° to 300°	2" Double Standard	Up to 3½" inclusive 4" and larger
301° to 355°	Double Standard 3"	Up to 3½" inclusive 4" and larger

FIELD WORK . . . in the installation of Ehret's Durant Insulated Pipe is simple and inexpensive. Full lengths can be joined by couplings, flanges or welding, and when a length requires cutting in the field, the asphalt and insulation can be removed as shown above and the pipe cut to the desired length with a cutter or torch.

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TRENCHING . . . for Durant Insulated Pipe need not be deep. The rugged strength of the asphalt protection withstands heavy impact of trains or trucks. Backfill can be made immediately after joints are completed without fear of damage.

FIELD JOINTS . . . **in the Durant System are insulated with 85% Magnesia and sealed with special high-melting-point asphalt. Metal jackets are furnished to facilitate making field joints and the jacket is left in place to provide additional protection.**

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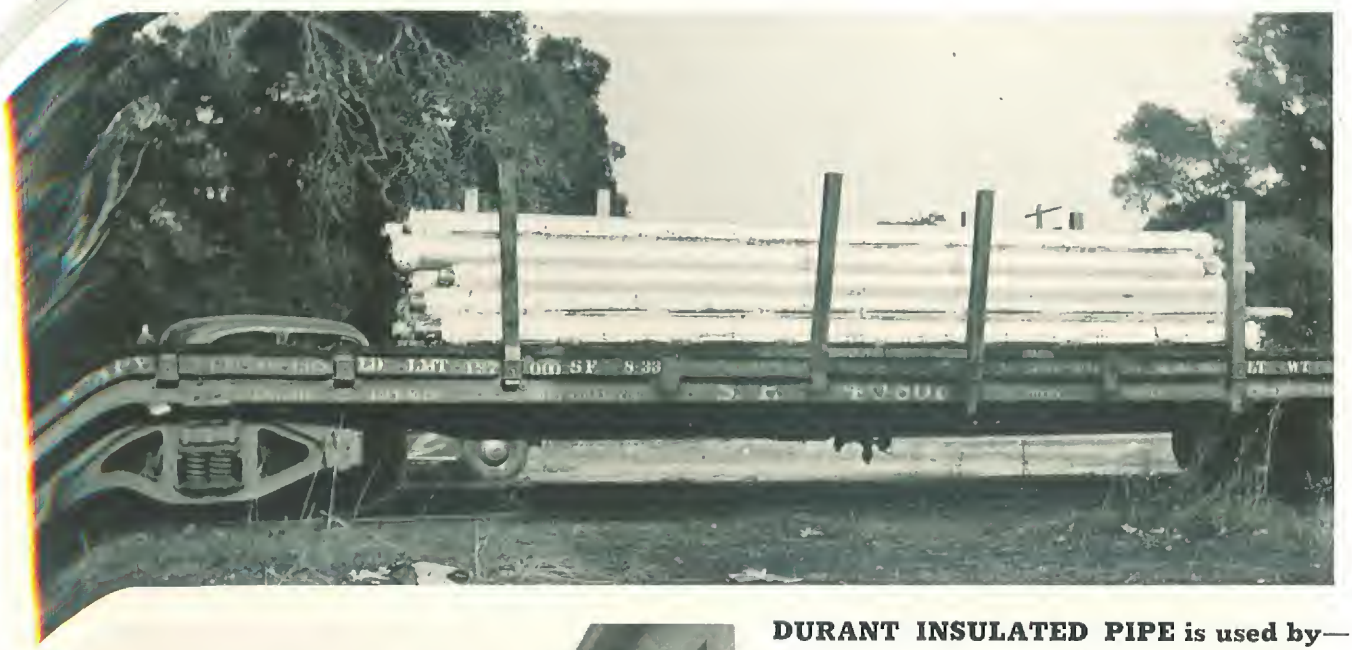

DURANT INSULATED PIPE is used by—

Air Reduction Corporation
Allegheny County Steam Heating Co.
Armour & Company
Boston & Maine Railroad
Chrysler Motors Corporation
City of Cleveland
Detroit Edison
E. I. du Pont de Nemours & Company, Inc.
F. H. A. Housing Projects
Ford Motor Company
Great Lakes Pipe Line Company
Lever Brothers
Monsanto Chemical Corp.
New York, New Haven & Hartford R. R.
Southern Pacific R. R.
Stanford University
Twentieth Century-Fox Corporation
U. S. Coast Guard
U. S. Navy
Viscose Company

. . . TYPICAL INSTALLATION VIEWS OF EHRET'S . . .

Durant Insulated Piping

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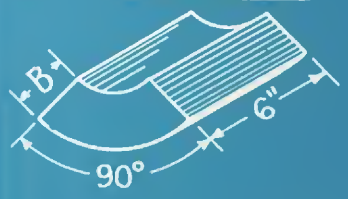
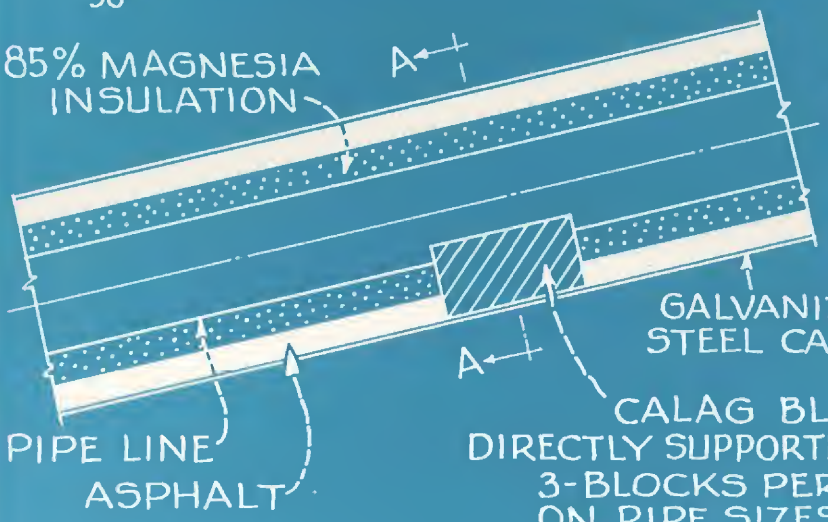
This view, taken at the Front Royal, Virginia, plant of the American Viscose Corporation shows 3″ supply and 1¼″ return lines of Durant Insulated Pipe, completely installed and ready for backfill.

CALAG BLOCK



DIMENSION "B" DEPENDENT UPON PIPE SIZE AND INSULATION THICKNESS DESIRED



SECTION A-A

NOTE

THESE CALAG BLOCK SUPPORTS ARE INCORPORATED IN THE FACTORY CONSTRUCTION OF ALL DURANT INSULATED PIPES ABOVE 2", NOMINAL SIZE. BLOCKS ARE LOCATED DIAMETRICALLY OPPOSITE TO THE LINE OF ASPHALT VENTS THAT SHOW ON THE OUTER CASING. IN INSTALLING D·I·P. (OTHER THAN VERTICALLY) THESE VENTS SHOULD ALWAYS BE AT THE TOP, SO THAT THE WEIGHT OF THE PIPE WILL REST ON THE CALAG BLOCKS. LOCATIONS OF THE SUPPORTING BLOCKS ARE STENCILED ON OUTSIDE OF CASING

DURANT SYSTEM.. METHODS OF CONSTRUCTION

LOCATION OF CALAG BLOCK SUPPORTS

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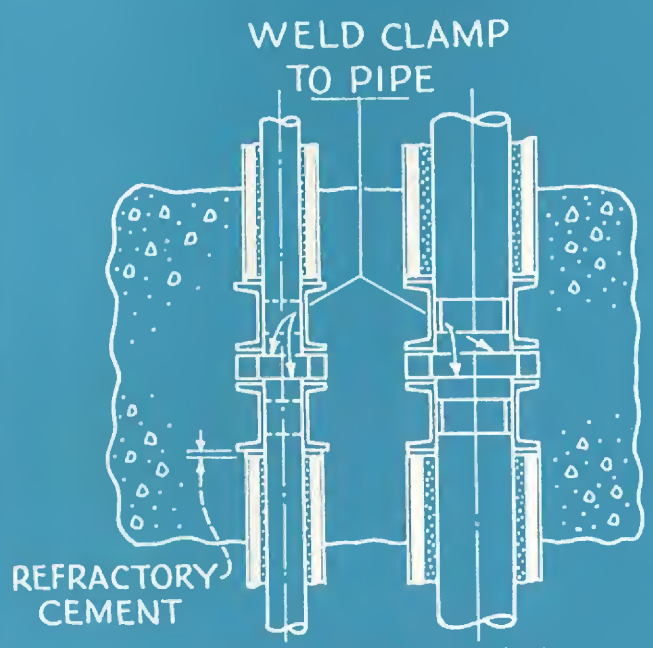
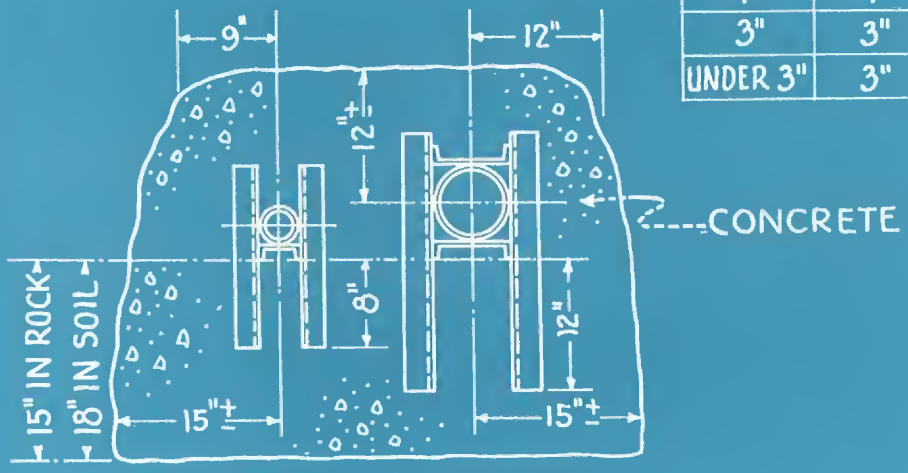


SECTIONAL PLAN

NOTE

DISTANCE BETWEEN AND LOCATION OF ANCHORS DEPENDS UPON THE TEMPERATURES TO BE CARRIED AND THE LAYOUT OF THE INDIVIDUAL INSTALLATION

PIPE SIZE	CHANNEL SIZE	CLAMP SIZE
8"	6"	3/8 × 1½
6"	6"	¼ × 1½
5"	6"	¼ × 1½
4"	4"	¼ × 1½
3"	3"	¼ × 1¼
UNDER 3"	3"	¼ × 1¼



SECTIONAL ELEVATION

DURANT SYSTEM •• RECOMMENDED CONSTRUCTION

•• PIPE LINE ANCHOR ••

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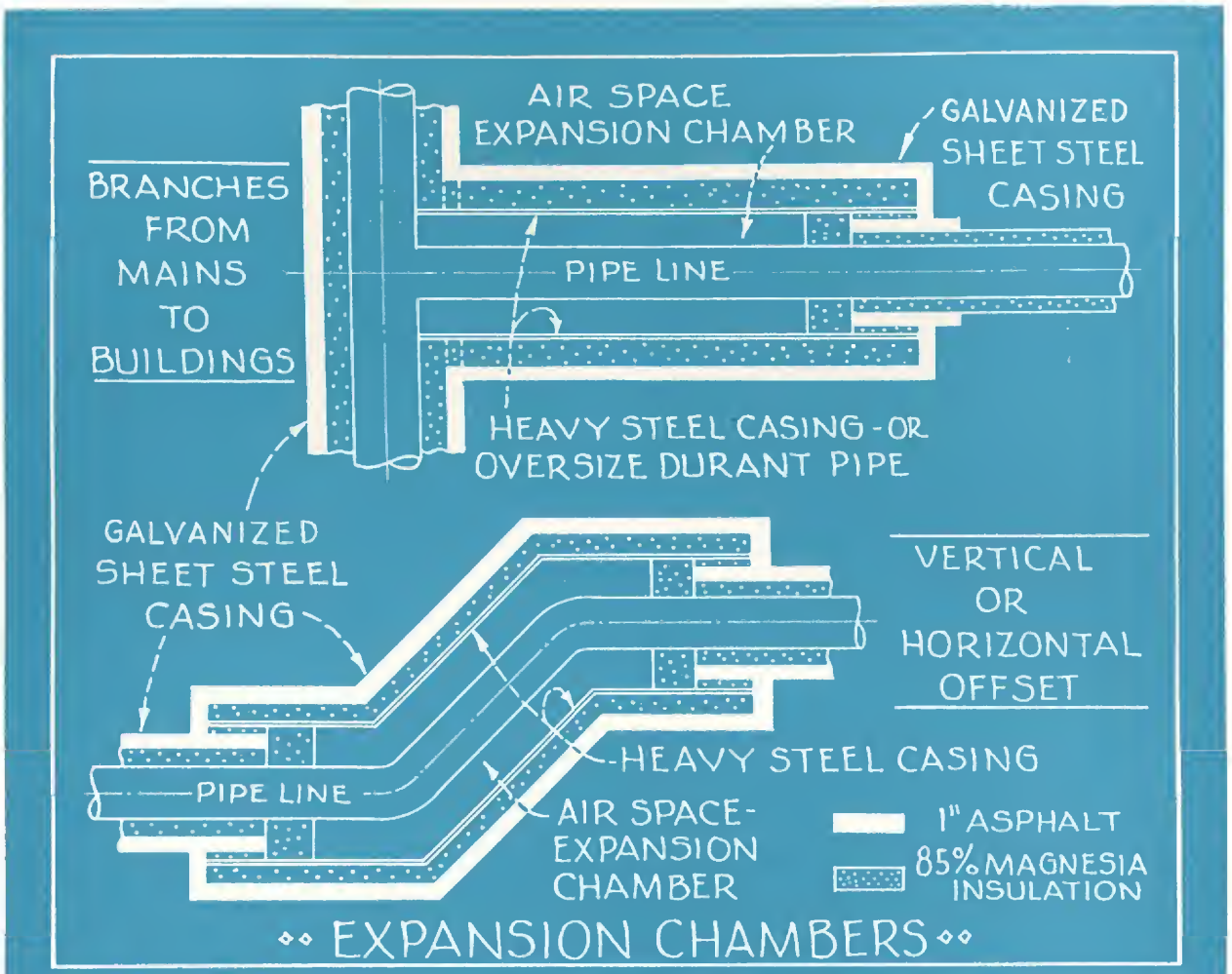
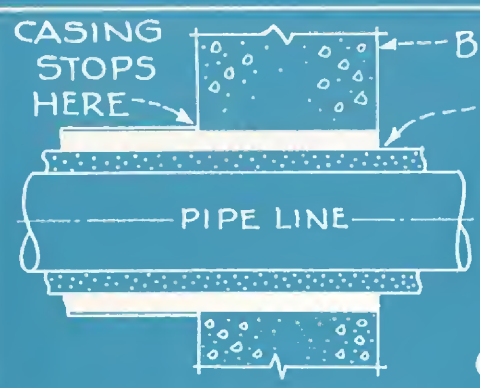


EXPANSION CHAMBERS



PIPE LINE ENTRANCE TO MANHOLE AND BUILDING WALLS

DURANT SYSTEM.. RECOMMENDED CONSTRUCTION

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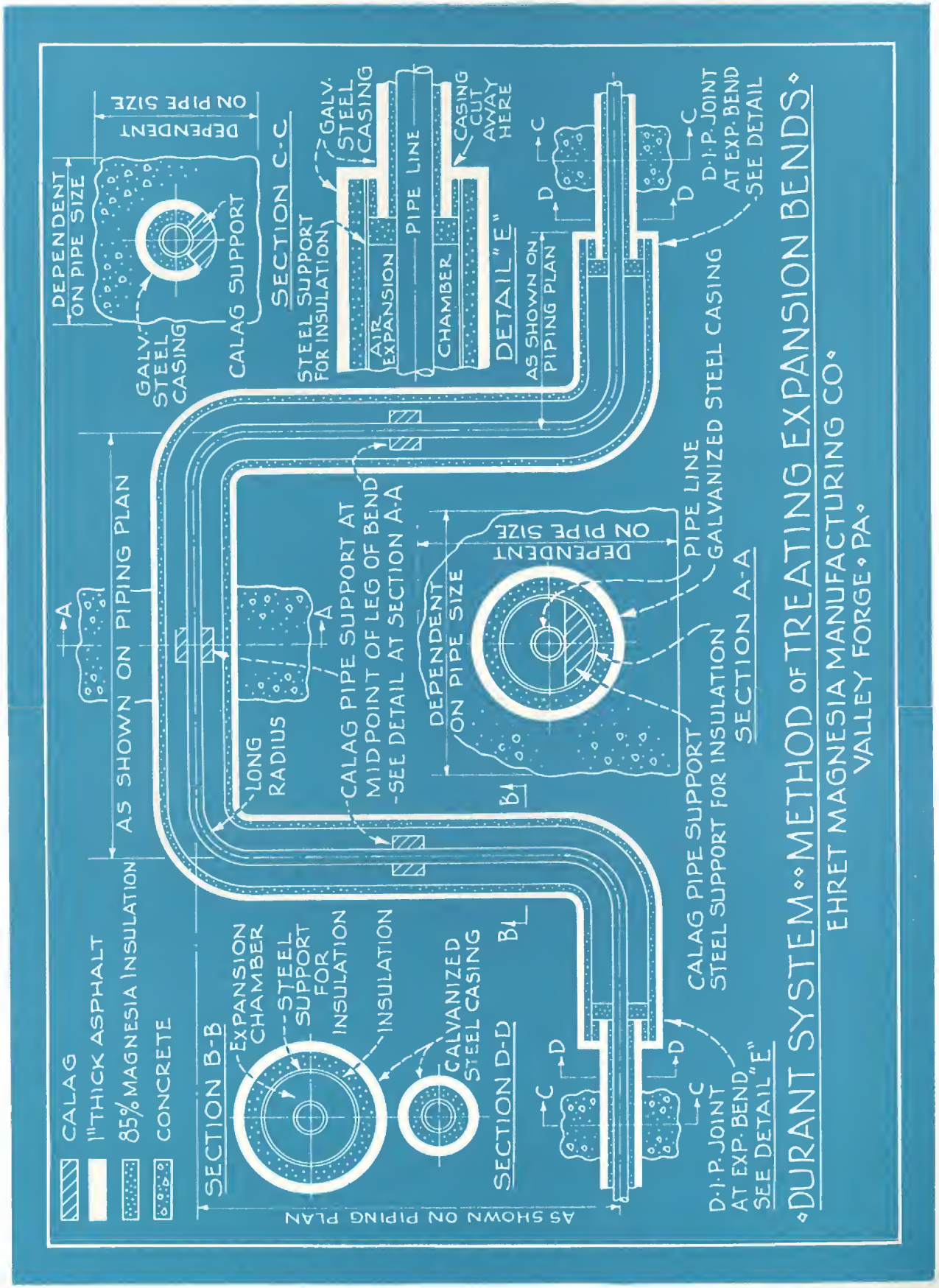

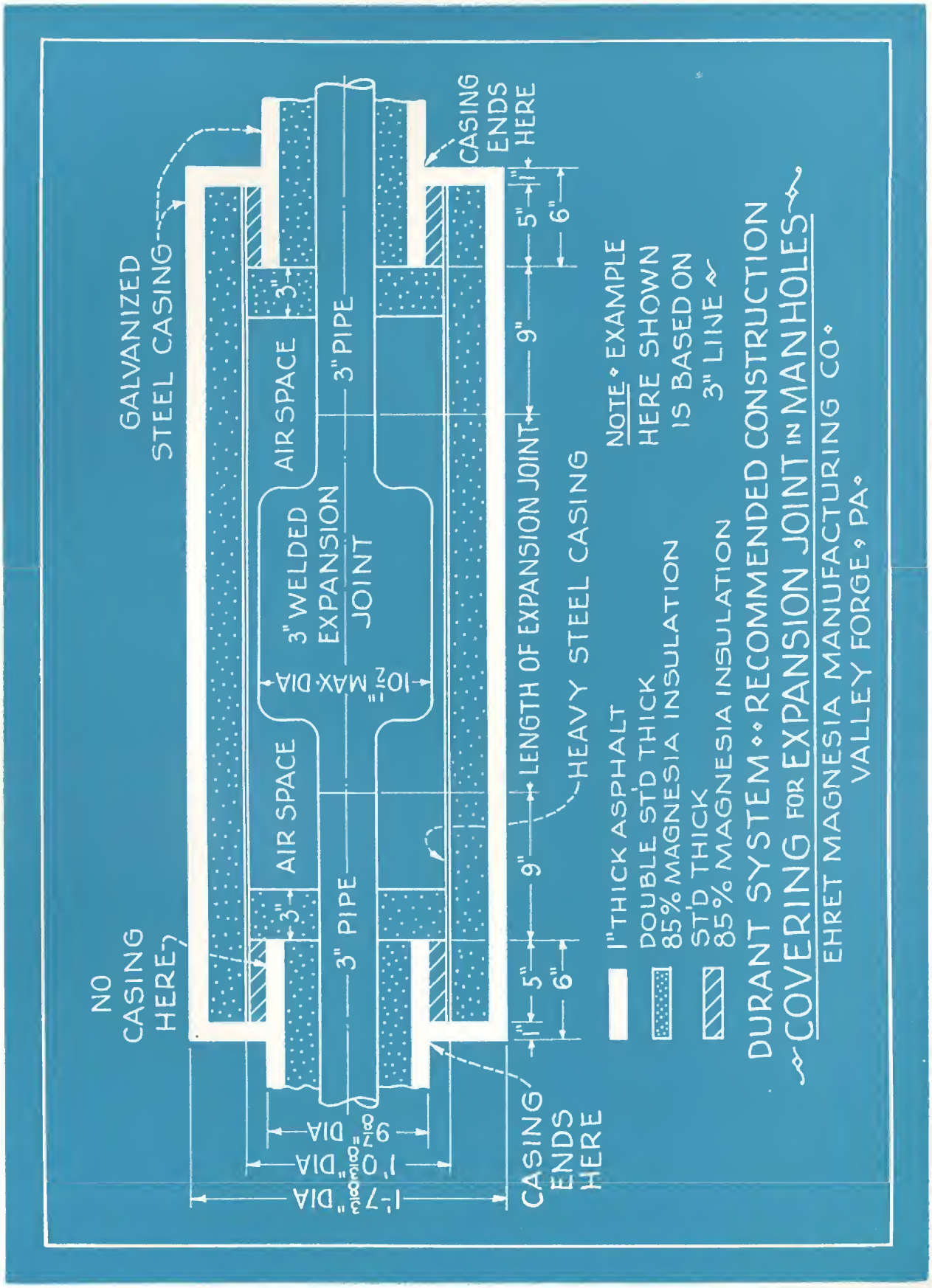

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ITEMIZED WEIGHTS OF DURANT SYSTEM PIPE

Pounds per Lineal Foot

Pipe Size	¾″	1″	1¼″	1½″	2″	2½″	3″	3½″	4″	4½″	5″	6″	7″	8″	9″	10″	12″	14″	16″	18″
Steel Pipe—only	1.14	1.69	2.28	2.73	3.68	5.82	7.62	9.20	10.89	12.64	14.81	19.19	23.77	28.81	34.18	40.48	49.56	54.56	62.57	76.84
No Insulation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
½″ Asphalt	1.05	1.20	1.51	1.68	2.01	2.36	2.80	3.14	3.49	3.94	4.24	4.98	5.68	6.37	7.07	7.95	9.25	10.12	11.52	12.92
Pipe and Asphalt	2.19	2.89	3.79	4.41	5.69	8.18	10.42	12.34	14.38	16.58	19.05	24.12	29.45	35.18	41.25	48.43	58.81	64.68	74.09	89.76
No Insulation	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1″ Asphalt	2.90	3.55	3.77	4.10	4.80	5.70	6.45	7.09	7.77	8.48	8.93	11.00	12.25	13.45	15.69	17.35	20.30	22.15	25.10	28.06
Pipe and Asphalt	4.04	5.24	6.05	6.83	8.48	11.52	14.07	16.29	18.66	21.12	23.74	30.19	36.02	42.26	49.87	57.83	69.86	76.71	87.67	104.90
St. Th. Magnesia	.60	.67	.80	.90	1.27	1.43	1.67	1.87	2.30	2.47	2.67	3.10	3.97	4.40	4.95	5.40	7.68	8.35	9.42	10.48
1″ Asphalt	5.90	6.21	6.76	7.11	8.42	9.11	9.94	10.76	11.59	12.19	13.04	14.76	16.48	17.96	18.65	20.06	23.55	25.30	28.10	30.90
Pipe, Mag. and Asphalt	7.64	8.57	9.84	10.74	13.37	16.36	19.23	21.83	24.78	27.30	30.52	37.05	44.22	51.17	57.78	65.94	80.79	88.21	100.09	118.22
Doub. St. Magnesia	1.77	1.94	2.14	2.44	3.24	3.64	4.07	4.47	5.34	5.87	6.34	7.17	9.10	9.97	10.87	11.90	16.84	18.30	20.43	22.56
1″ Asphalt	8.76	9.20	9.50	10.00	11.34	12.17	13.10	13.86	15.00	15.74	16.21	18.09	20.35	21.76	22.16	23.56	27.75	28.50	32.30	35.08
Pipe, Mag. and Asphalt	11.67	12.83	13.92	15.17	18.26	21.63	24.79	27.53	31.23	34.25	37.36	44.45	53.22	60.54	67.21	75.94	94.15	101.36	115.30	134.48
1½″ Th. Magnesia	1.34	1.54	1.70	1.84	2.10	2.40	2.67	2.97	3.24	3.50	3.80	4.34	4.90	5.44	6.00	6.60	7.68	8.35	9.42	10.48
1″ Asphalt	8.07	8.47	8.95	9.17	9.90	10.45	11.35	12.10	12.76	13.28	14.10	15.66	16.80	18.30	19.37	20.68	23.55	25.30	28.10	30.90
Pipe, Mag. and Asphalt	10.55	11.70	12.93	13.74	15.68	18.67	21.64	24.27	26.89	29.42	32.71	39.19	45.47	52.55	59.55	67.76	80.79	88.21	100.09	118.22
2″ Th. Magnesia	2.23	2.43	2.63	2.80	3.10	3.53	3.97	4.30	4.67	5.07	5.47	6.20	6.93	7.67	8.33	9.17	10.57	11.49	12.91	14.33
1″ Asphalt	9.22	9.52	10.14	10.56	11.25	11.86	12.90	13.66	14.00	14.74	15.54	17.29	18.42	20.20	20.86	22.16	23.96	26.70	29.50	32.30
Pipe, Mag. and Asphalt	12.59	13.64	15.05	16.09	18.03	21.21	24.49	27.16	29.56	32.45	35.82	42.68	49.12	56.68	63.37	71.81	84.09	92.75	104.98	123.47
2½″ Th. Magnesia	3.22	3.44	3.78	3.94	4.39	4.84	5.40	5.84	6.29	6.73	7.23	8.00	9.10	9.97	10.87	11.90	13.68	14.80	16.57	18.36
1″ Asphalt	10.50	10.90	11.50	11.90	12.40	13.00	13.80	14.70	15.60	16.50	17.40	18.80	20.35	21.76	22.16	23.56	26.20	27.80	30.70	33.50
Pipe, Mag. and Asphalt	14.86	16.03	17.56	18.57	20.37	23.66	26.82	29.74	32.78	35.87	39.44	45.99	53.22	60.54	67.21	75.94	89.44	97.16	109.84	128.70
3″ Th. Magnesia	4.40	4.67	5.07	5.34	5.80	6.37	7.00	7.54	8.07	8.64	9.24	10.34	11.47	12.50	13.64	14.70	16.84	18.30	20.43	22.56
1″ Asphalt	11.30	11.70	12.20	12.50	12.80	13.90	14.70	15.50	16.20	16.80	17.60	19.20	20.60	22.00	23.60	25.10	27.75	28.50	32.30	35.08
Pipe, Mag. and Asphalt	16.84	18.06	19.55	20.57	22.28	26.09	29.32	32.24	35.16	38.08	41.65	48.73	55.84	63.31	71.42	80.28	94.15	101.36	115.30	134.48
3½″ Th. Magnesia	5.76	6.09	6.54	6.80	7.45	8.05	8.80	9.45	10.05	10.75	11.40	12.75	14.00	15.30	16.70	18.00	20.40	21.90	24.70	27.10
1″ Asphalt	12.70	13.10	13.60	14.00	14.50	15.30	16.20	16.80	17.30	18.20	18.90	20.60	22.00	23.30	25.30	26.20	29.10	30.70	33.50	36.20
Pipe, Mag. and Asphalt	19.60	20.88	22.42	23.53	25.63	29.17	32.62	35.45	38.24	41.59	45.11	52.54	59.77	67.41	76.18	84.68	99.06	107.16	120.77	140.14

EHRET

INSULATION RECOMMENDATIONS

and

SPECIFICATION FORMS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. HCI 400a

Printed in U. S. A.

EHRET

INSULATION RECOMMENDATIONS

MATERIALS and METHODS OF APPLICATION

- BOILERS
- POWER EQUIPMENT
- HEATING
- PIPING
- AIR CONDITIONING
- REFRIGERATION

THE EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. HCI 400

Printed in U. S. A. 6-38

EHRET INSULATIONS

CONTENTS

FOREWORD

These insulation recommendation data sheets have been prepared by Ehret engineers as a guide for those interested in the use and application of thermal insulations. The range of subjects included necessitates a somewhat brief and general treatment which, in many cases, should be supplemented with a study of the particular conditions involved. It is normal practice for the Ehret Company and their representatives to assist in such insulation surveys.

The recommendations given in these data sheets are based on the premise that materials will be applied by skilled applicators. The best of materials, if improperly or carelessly handled or applied, are not likely to render the full economy and service that should rightfully be expected. The Ehret Company recommends that in all cases insulating materials be applied by their approved insulation contractors. Ehret distributors and approved contractors, a list of which appears in this book, will be pleased to discuss your insulation problems with a view to making particular recommendations where needed.

EHRET MAGNESIA MANUFACTURING CO.

Executive Office and Factories

Valley Forge, Pa.

Branch Offices—NEW YORK, CHICAGO and PHILADELPHIA

Printed in U. S. A. 6-38

INSULATION RECOMMENDATIONS

BOILERS AND BOILER SETTINGS

Severe demands on boilers are today the rule rather than the exception. Under these conditions proper insulation of boiler settings is of considerable importance.

The proper insulation of boiler settings tends to equalize temperatures throughout the refractory lining, thereby reducing internal strains and prolonging the useful life of the structure. Insulated boiler walls are free from undesirable air infiltration and the use of insulation permits thinner brick construction.

Uninsulated boiler walls are not only the source of much lost heat, but also the heat that is wasted is quite likely to result in uncomfortable working conditions, with a subsequent lowering of efficiency of those who work in or near the boiler room.

WATER-COOLED WALLS

Materials

Widely used on water-cooled boiler walls, Ehret's 85% Magnesia and Ehret's Enduro high temperature insulation have demonstrated their fitness for this severe service. Besides being durable and efficient, these materials are not difficult to remove and re-apply when boiler wall tube replacements or repairs are necessary. The characteristic permanency of both materials insures against deterioration, disintegration, and settling.

Application

The exact method to be followed will depend on the particular type of water wall. In general, the following will apply. (Figs. 1, 2 and 3).

When tubes, clamps, nuts, bolts, or metal projections are exposed on the exterior side of the water tube wall, a filler coat of Ehret's No. 18 Heat-Seal Insulating Cement should be applied just thick enough to cover the high points. This is to be trowelled to a level, smooth surface.

If the temperature of this cement surface will not exceed 600° F., 85% Magnesia Block should be applied. If this cement surface temperature is to exceed 600° F., a combination insulation should be used, consisting of an inner layer of Ehret's Enduro Block covered with an outer layer of Ehret's 85% Magnesia Block, the total thickness

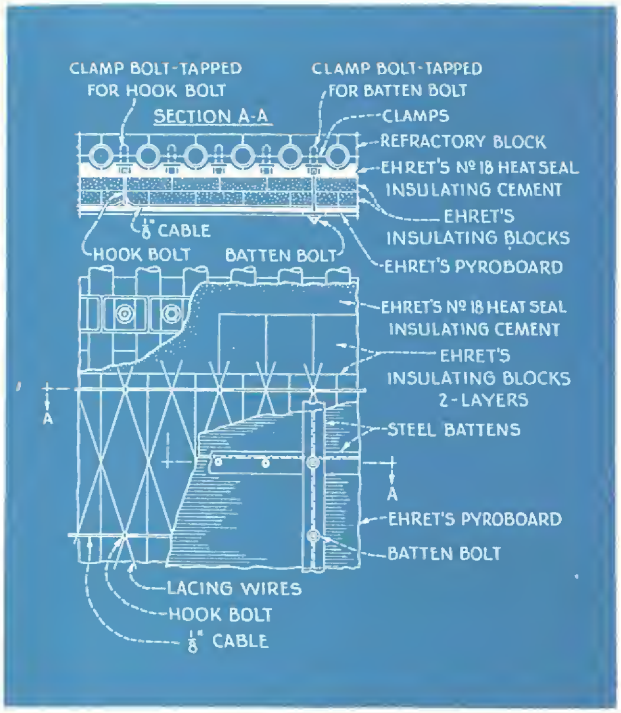

Fig. 1

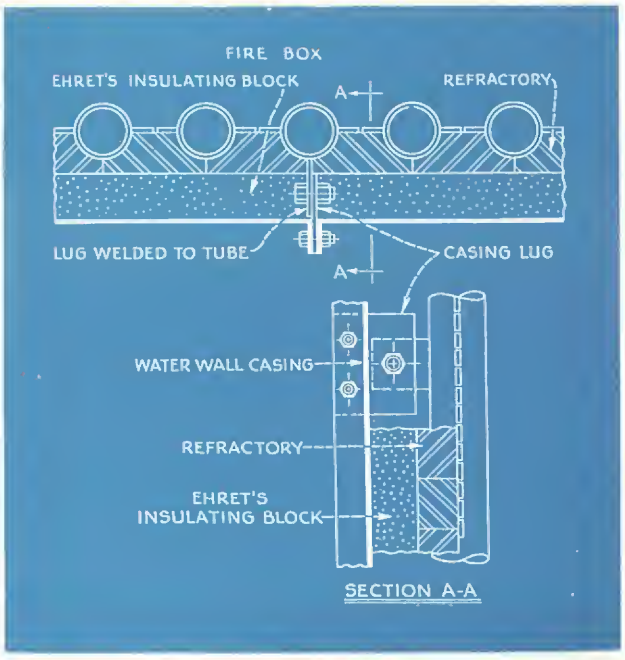

Fig. 2

of the insulation in every case to depend on the insulating effect desired. In order that a wall tube may be replaced with minimum disturbance to the insulation, the blocks should be placed with the longest (36") dimension vertical. Edges of the two layers of blocks should be staggered so that

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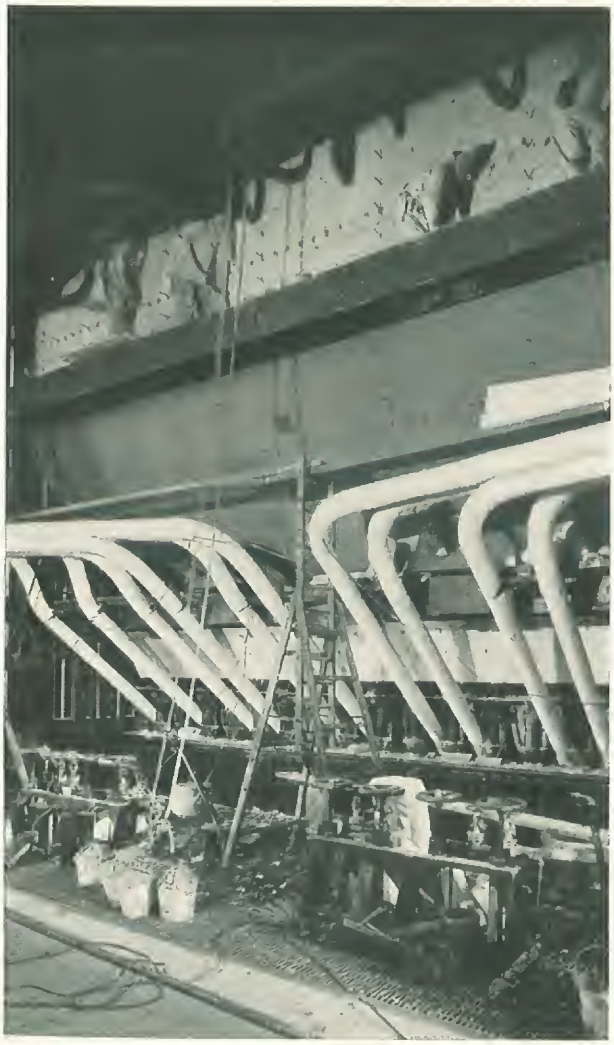
all joints will be broken or sealed, and the outer layer of blocks should be pointed up thoroughly with Ehret's No. 150 Asbestos Cement. The blocks may be spotted with Ehret's Fibrous Adhesive to hold them in place while the 1/8" wire cables and No. 16 gauge annealed iron wire lacings are being attached.

Panel Finish

To provide easy access to the insulation, the outer surface of the wall should consist of removable panels of Ehret's Pyroboard, 3/8" thick. These panels should be tightly held in place against the insulation blocks by means of vertical strip steel battens drawn tight by nuts. The bolts or threaded rods used to hold the vertical battens should be so spaced that the panels will fit in between them. Short horizontal battens reaching



Ehret's No. 18 Heat Seal Cement and Magnesia blocks, 3" thick, being applied to a B&W Boiler, at the Richmond St. Station of the Phila. Elec. Co.

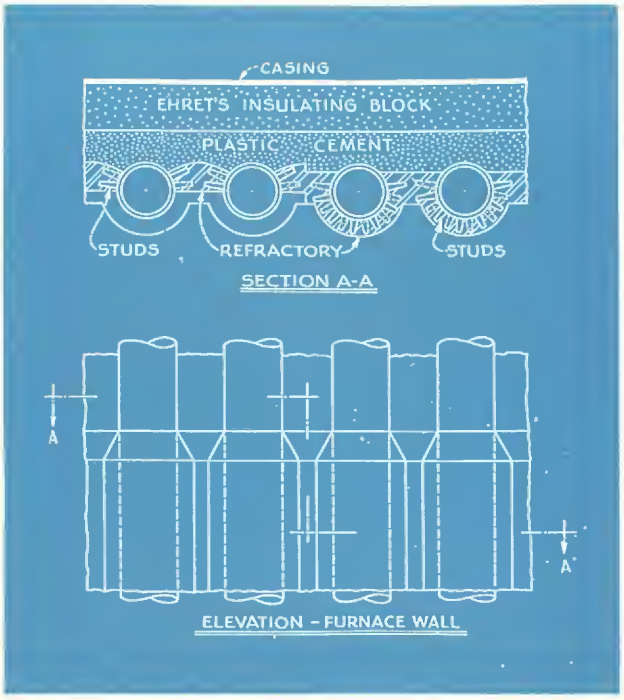


Fig. 3

between vertical battens should be placed over the horizontal joints and held in place by being bolted to the top edge of each panel, allowing the batten to project upward over the lower edge of the panel above; or, lugs can be welded under the ends of the horizontal batten strips so that they project into the crack between the panels and under the vertical battens. Because of contraction and expansion of the furnace walls, the outside panels should not be directly bolted down or too closely held edgewise by the battens.

Cement Finish

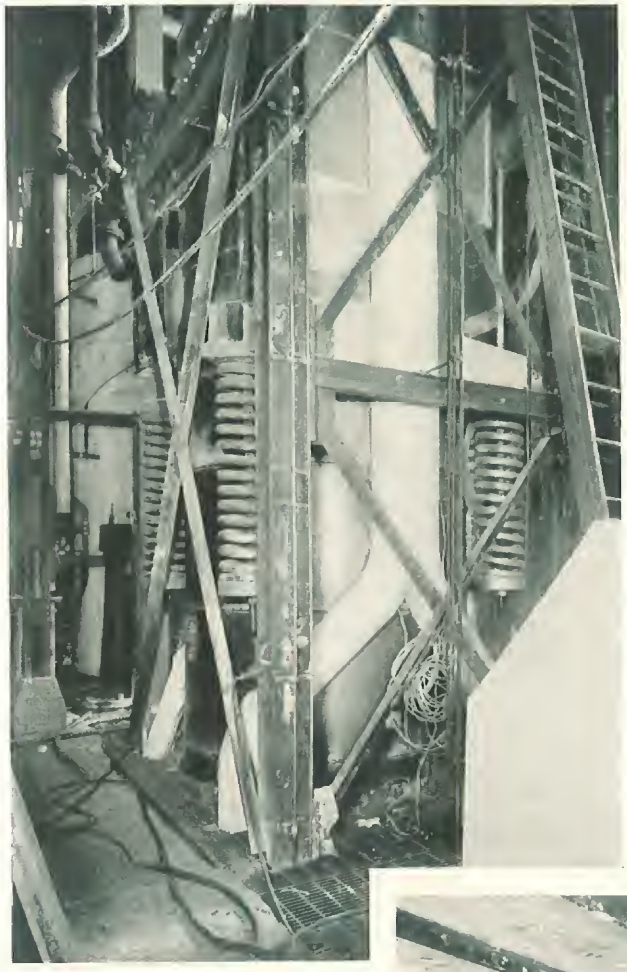
Although the panel finish is preferable because it permits easy access to water tubes, a cement finish can be used if required. In such cases a finish consisting of Ehret's No. 150 Asbestos Cement may be applied. The blocks should be anchored with 1/8" wire cables and lacings as described for the panel finish, but in addition, 1½" hexagonal mesh netting should be tightly and securely fastened over the surface of the blocks. Anchorages should not project appreciably beyond the outer surface of the blocks.

Over the wire mesh Ehret's No. 150 Asbestos Cement should be applied in two layers to a total thickness of at least ½", with the outer layer trowelled to a smooth finish. Where an extremely hard surface is desired, the outer layer should contain 1/3 by weight of portland cement.

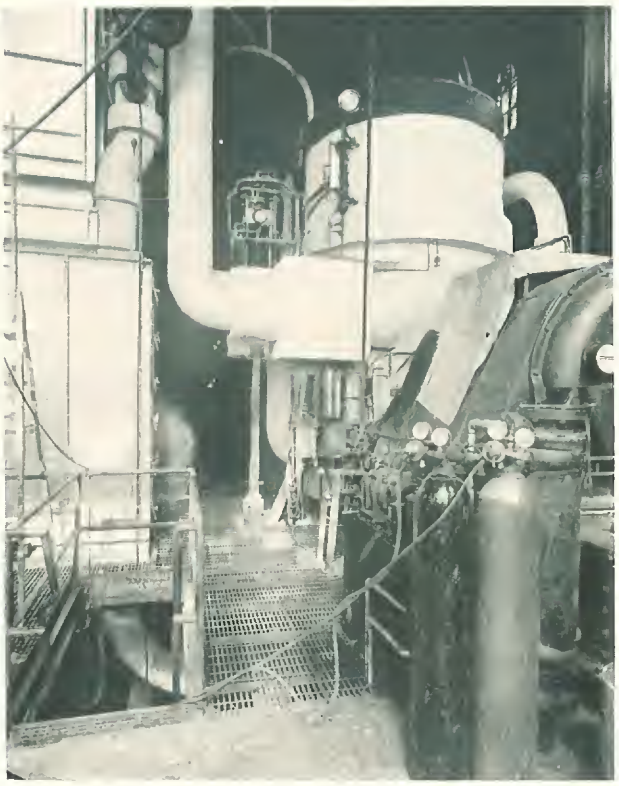
EHRET INSULATIONS

AN UNUSUAL BOILER INSTALLATION . . .

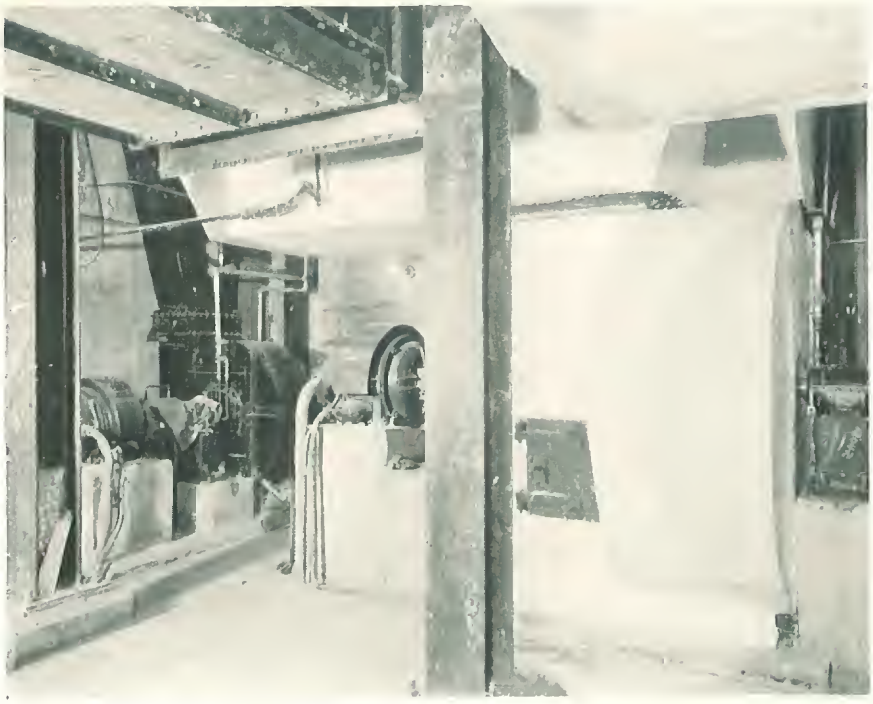
a Mercury Vapor Boiler, auxiliary piping and equipment, all protected with Ehret's Insulations.



(Above). The General Electric mercury vapor boiler and down pipes are insulated with Ehret's Enduro 1½" thick, and Ehret's 85% Magnesia 1½" thick. Temperatures of the protected surfaces approximate 1000° f.



(Above). Mercury condenser covered with Ehret's 85% Magnesia 3" thick.



(Right). Air and gas flues and blower housings. Temperatures of air flues range up to 632° f. and they are insulated with Ehret Rock Wool Blankets up to 3" thick. The outer finish consists of Ehret's Asbestos Cement trowelled smooth over the blanket insulation.

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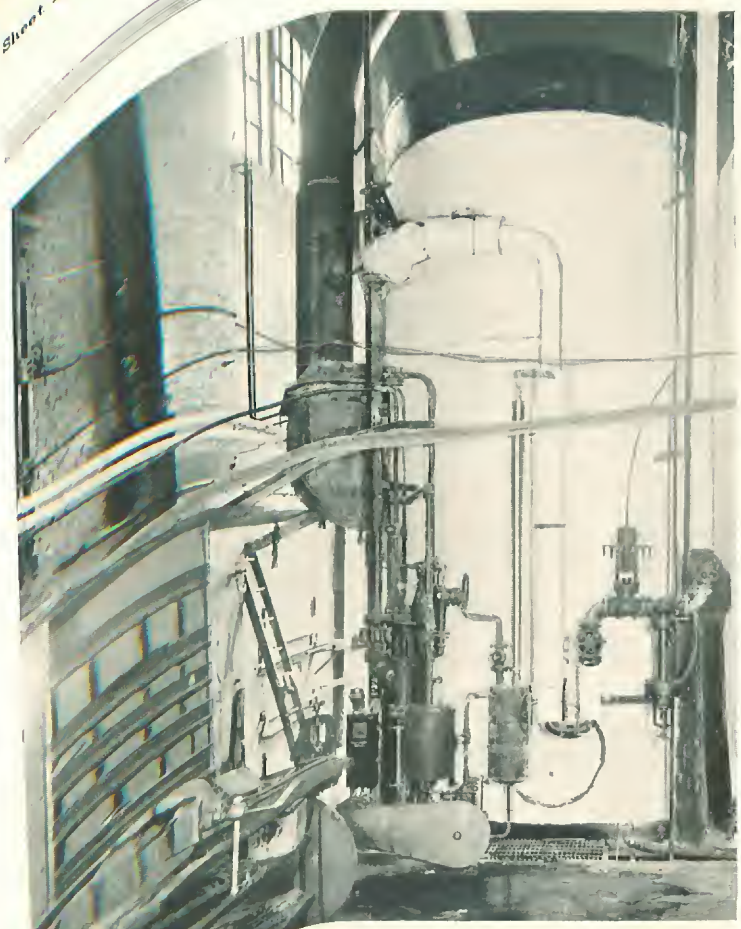
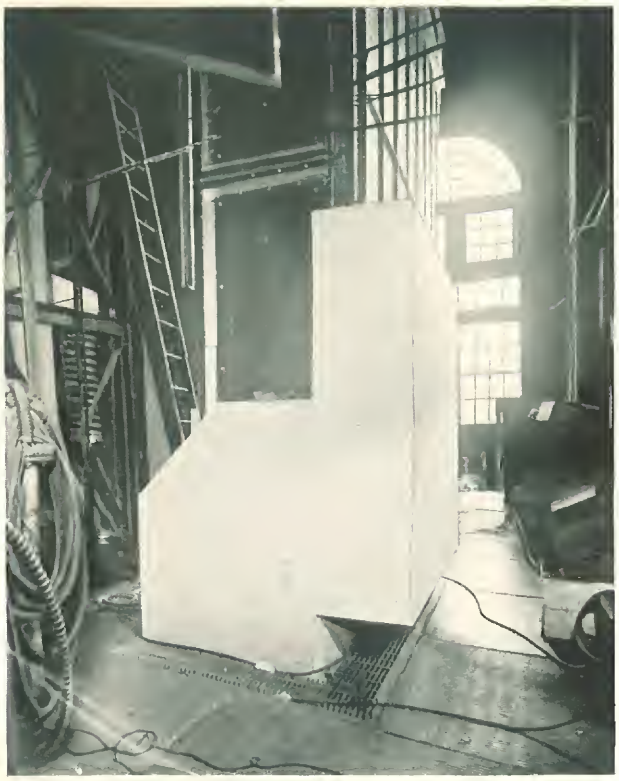
Sheet No. HCI 403

EHRET
INSULATIONS

AUXILIARY EQUIPMENT
for the
MERCURY VAPOR BOILER





(Above). A 632° f. air flue protected with Ehret's Rock Wool Blankets 3″ thick.

(Left above). Condenser and piping protected with Ehret's 85% Magnesia block and pipe coverings that are applied in two layers to a total thickness of 3 inches.

(Left) In the upper right hand corner of this illustration is a gas flue carrying temperatures up to 890° f. It is insulated on the inside with a layer of plastic cement on top of which is placed a layer of Ehret's 85% Magnesia Block 1½″ thick, and a layer of Ehret's Enduro Block 1½″ thick, the whole covered with wire mesh and a hard finish of asbestos cement.

AIR-COOLED WALLS

In air-cooled boiler wall construction, air passages over the outside of the refractory walls are provided so that the incoming air passes over the hot refractory walls and is pre-heated before going into the furnace. These air passages are formed by a strong, fire-proof construction which is sufficiently tight to prevent infiltration or escape of air. Passages are so designed that they have the desired heating effect on the incoming air and also a minimum resistance to the circulation of the air.

Construction

The exterior wall is made of insulating panels attached to the supporting steelwork of the boiler setting. This wall is to be built before the brickwork is started, and the brickwork is then hung or placed so that an air space is left between the inside of the insulating wall and the outside of the refractory wall. (Figs. 4 and 5).

Materials and Application

The exterior insulating panels are made up in units at the factory and consist of Ehret's Asbestofibre Felted Sheet 1" thick between an outer sheet of Ehret's Pyroboard $\frac{3}{8}$" thick, and an inner sheet of Ehret's Asbestos Millboard $\frac{1}{4}$" thick. The three layers of material are held together with bolts, using standard washers under the heads on the outer surface and large plate washers under the nuts on the inner surface. The width of the panels should be such as to permit them to fit between and lightly clear the vertical buck stays. On the two vertical edges, the three layers of insulation are flush. The upper edges of panels have the insulating lining set in far enough to permit the downward-projecting flange of the horizontal structural member to fit in between the hard panel-boards. The lower edges of panels have the inner hard panel-board and the insulating lining set back far enough to clear the upward-projecting flange of the horizontal structural member.

To seal the space under the bottom edges of the panels, the upper half of the horizontal structural members should be filled with Ehret's No. 18 Heat-Seal Insulating Cement as panels are installed.

In order to protect the inside surfaces of the vertical buck stays, which are not covered by the panels, a strip of Ehret's Asbestofibre Felted Sheet 1" thick under a strip of Ehret's Asbestos Millboard $\frac{3}{4}$" thick should be bolted to each buck stay, using large plate washers under the nuts. (See section A-A, Fig. 4.)

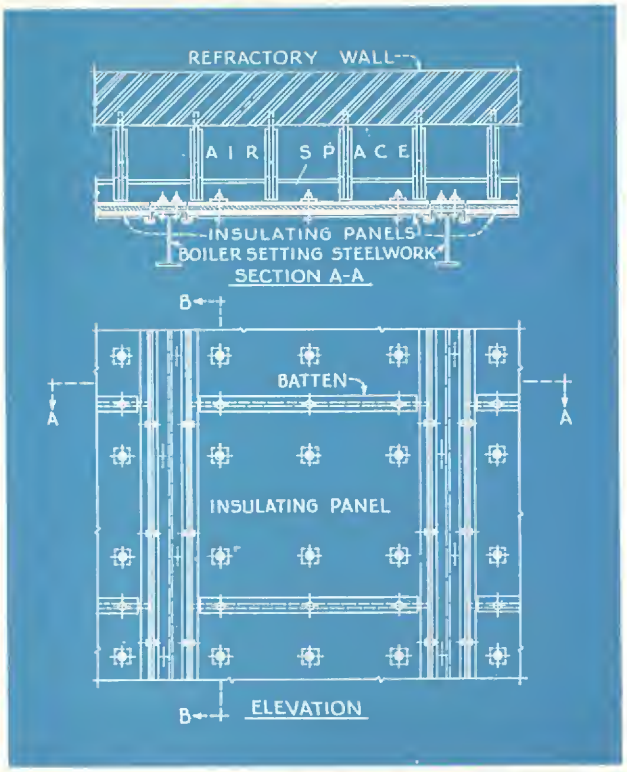


Fig. 4

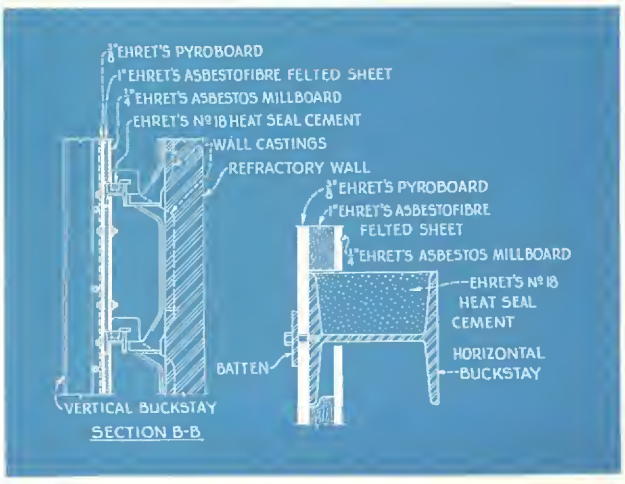


Fig. 5

Panels may be held in place by means of $\frac{1}{4}$" x $2\frac{1}{2}$" strip steel battens along the horizontal joints, secured with $\frac{3}{8}$" bolts or cap screws to the horizontal structural members. Light angles, $1\frac{1}{2}$" x $1\frac{1}{2}$", with slotted holes for $\frac{3}{8}$" bolts on 18 inch spacings should be bolted to each side of the buck stays to clamp and seal the vertical sides. Air leaks should be prevented by using Ehret's Twisted Asbestos Rope Packing $\frac{3}{8}$" thick, where needed.

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EHRET
INSULATIONS

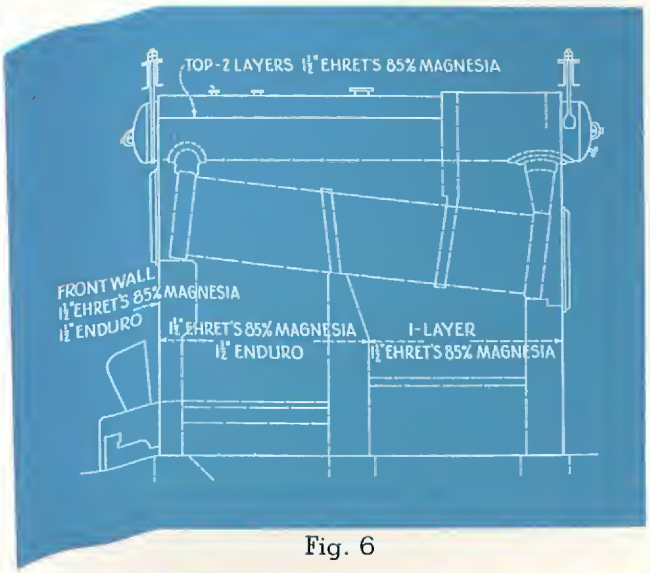


Fig. 6

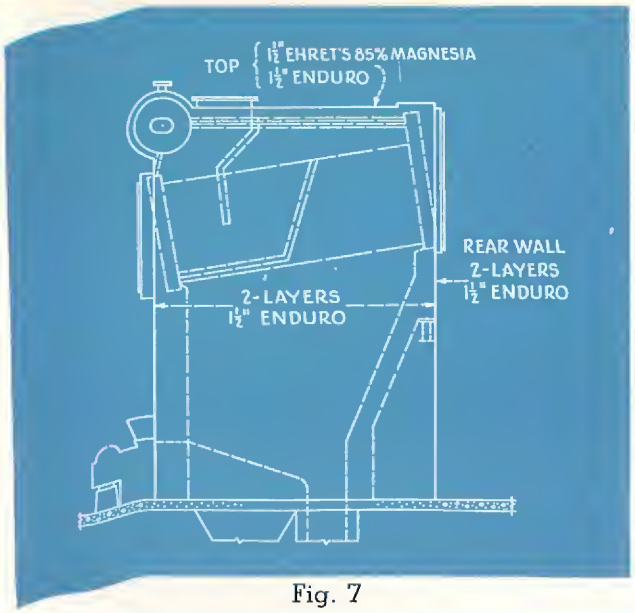


Fig. 7

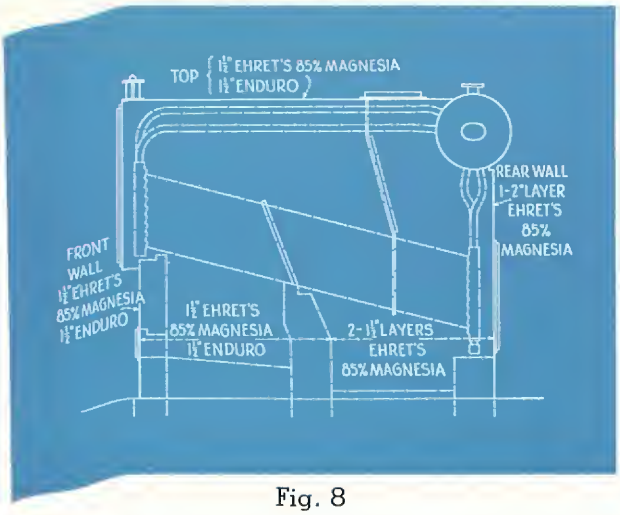


Fig. 8

SOLID FIREBRICK WALLS

Numerous types of boilers have solid firebrick walls. For purposes of simplification, the following general classifications are made:

Type 1—Longitudinal Drum Boilers (Fig. 6)

Type 2—Cross Drum, Straight Tube Boilers (Fig. 7)

Type 3—Cross Drum, Bent Tube and Multiple Drum, Bent Tube Boilers. (Figs. 8 and 9).

Recommended insulation thicknesses are based on the wall thicknesses shown in the following table, these thicknesses representing common practice in boiler wall construction. If actual thicknesses differ appreciably from these figures, Ehret engineers will be glad to make specific recommendations for the particular conditions.

Thickness of Brickwork	
Furnace walls	18"
Side walls, back of bridge wall	13½"
Rear wall, of longitudinal drum, cross drum bent tube and multiple drum types	13½"
Side and rear walls of the cross drum straight tube type, without bridge wall	22½"

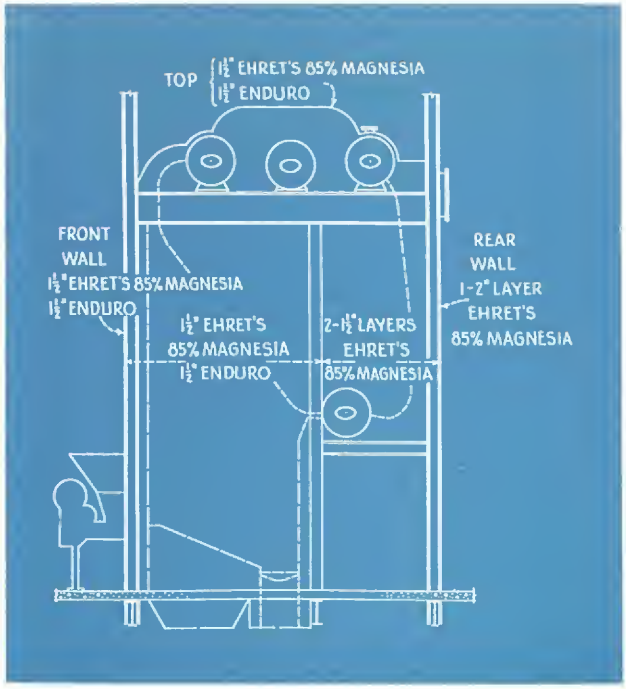


Fig. 9

BLOCK TYPE INSULATION

Materials

For use on temperatures ranging up to 600° F., Ehret's 85% Magnesia Block satisfactorily answers the needs. For temperatures above 600° F., Ehret's Enduro Block or a combination of Ehret's Enduro and Ehret's 85% Magnesia Block should be used, as recommended.

Type 1. Longitudinal Drum Boilers (Figs. 6 and 10).

The BOILER TOP should be insulated with two layers of Ehret's 85% Magnesia, each layer 1½" thick.

The FRONT WALL and the SIDE WALLS in FRONT of the bridge wall should be insulated with a layer of Ehret's Enduro 1½" thick, covered with a layer of Ehret's 85% Magnesia 1½" thick.

The SIDE WALLS BEHIND the bridge wall should be insulated with one layer of Ehret's 85% Magnesia 1½" thick.

The REAR WALL need not be insulated.

Type 2. Cross Drum, Straight Tube Boilers. (Fig. 7).

The BOILER TOP should be insulated with one layer of Ehret's Enduro 1½" thick, covered with one layer of Ehret's 85% Magnesia 1½" thick.

The FRONT WALL need not be insulated.

The SIDE WALLS and REAR WALL should be insulated with two layers of Ehret's Enduro, each layer 1½" thick.

Type 3. Cross Drum, Bent Tube Boilers and Multiple Drum, Bent Tube Boilers. (Figs. 8, 9, 11 and 12).

The BOILER TOP should be insulated with one layer of Ehret's Enduro 1½" thick, covered with one layer of Ehret's 85% Magnesia 1½" thick.

The FRONT WALL and the SIDE WALLS in FRONT of the bridge wall should be insulated with one layer of Ehret's Enduro 1½" thick, covered with one layer of Ehret's 85% Magnesia 1½" thick

The SIDE WALLS BEHIND the bridge wall should be insulated with two layers of Ehret's 85% Magnesia, each layer 1½" thick.

The REAR WALL should be insulated with one layer of Ehret's 85% Magnesia 2" thick.

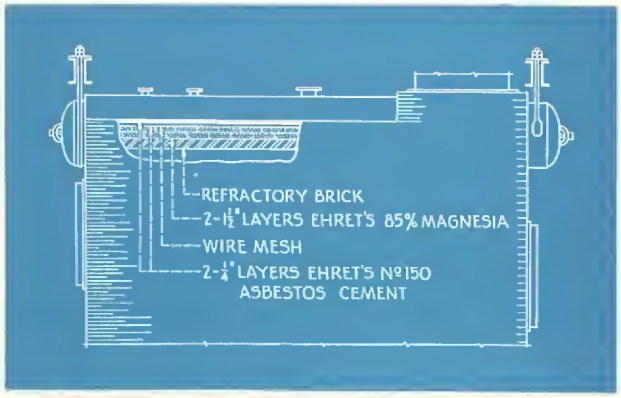


Fig. 10

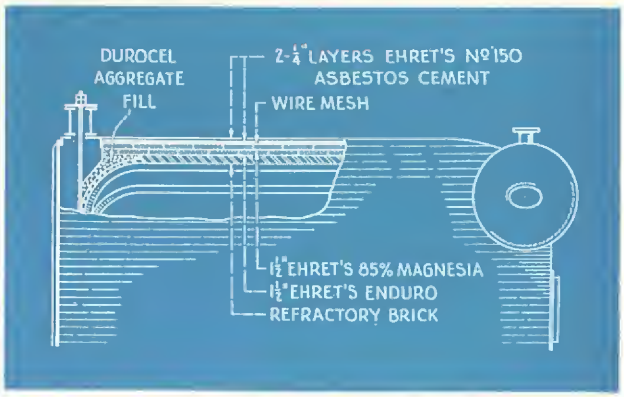


Fig. 11

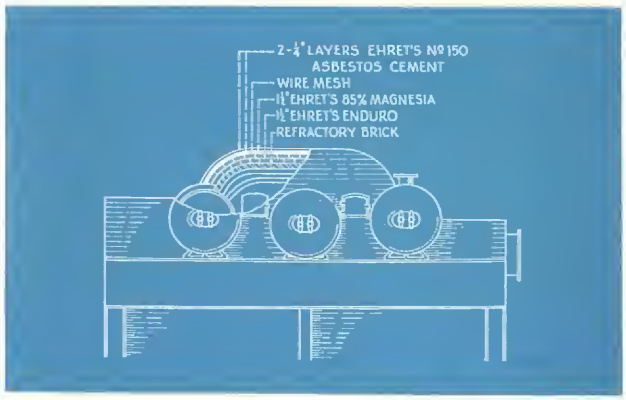
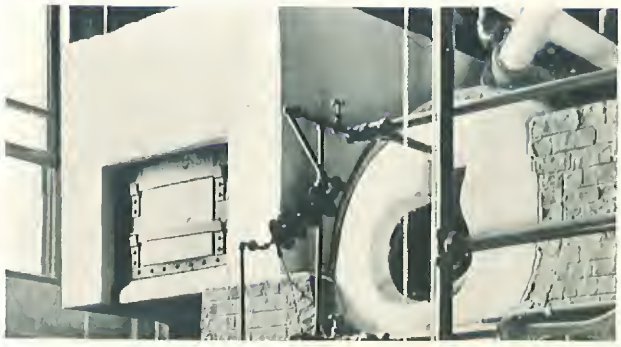


Fig. 12



Breeching and drum head insulation on a longitudinal drum boiler, showing beveled opening.

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Application—Boiler Tops

In every case, the insulating blocks should be placed over the brickwork with all joints staggered and pointed up with Ehret's No. 150 Asbestos Cement. Two-inch hexagonal mesh netting should then be stretched closely over the block surface and wired down to bolts or other solid anchorages previously installed by the setting contractor. (Figs, 13 and 14).

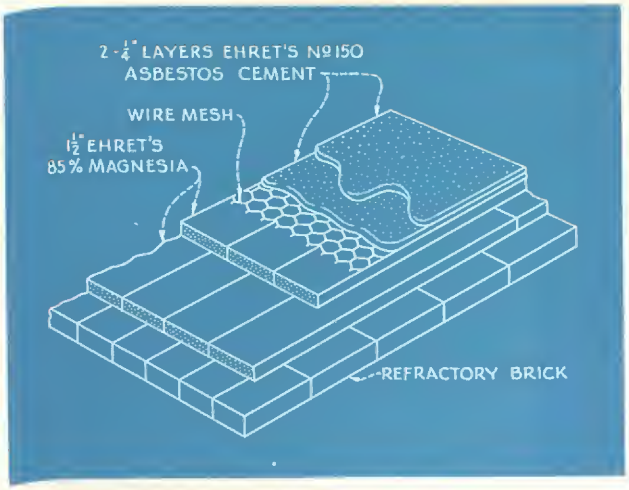


Fig. 13

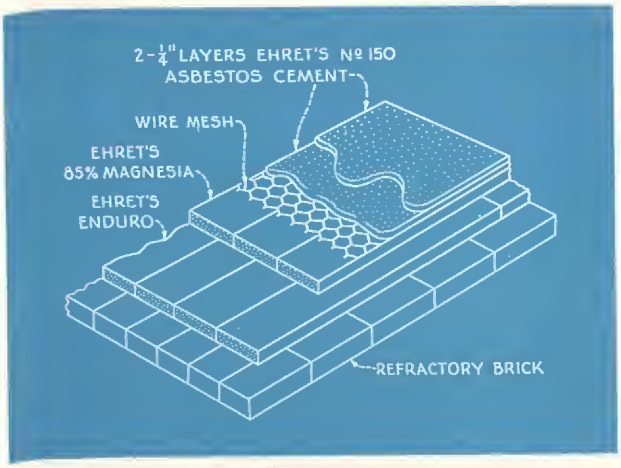


Fig. 14

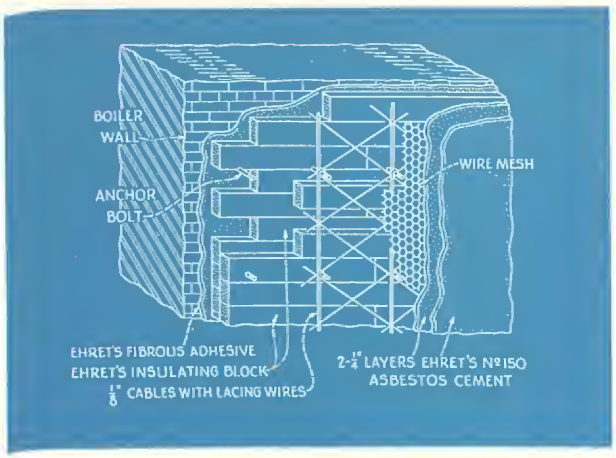


Fig. 15

As a protective finish, two layers of Ehret's No. 150 Asbestos Cement totalling at least ½" thickness should be applied over the wire netting on the blocks, the second layer to be trowelled to a smooth, hard surface. If an exceedingly hard finish is desired, the second layer should contain ⅓ by weight of portland cement. It is sometimes advisable to lay a course of red brick over the finishing coat on boiler tops, preferably while the last coat of cement is still wet, to prevent damage by workmen who may be required to walk across the boiler top to operate and service valves or equipment.

Application—Walls

For supporting or anchoring the insulation, angles, clips or anchor bolts should be set at proper locations. The outer surfaces of both old and new brickwork should be cleaned and made free from dust, and a thin coating of Ehret's Fibrous Adhesive should be applied to make the wall air-tight as well as to hold the first layer of blocks in place. The application of the adhesive should proceed as the installation of the first layer of blocks progresses, and where a second layer of blocks is required all joints should be staggered. Spotting the surfaces between the first and second layers with Ehret's Fibrous Adhesive facilitates application and results in a sturdier construction. (Figs. 15 and 16).

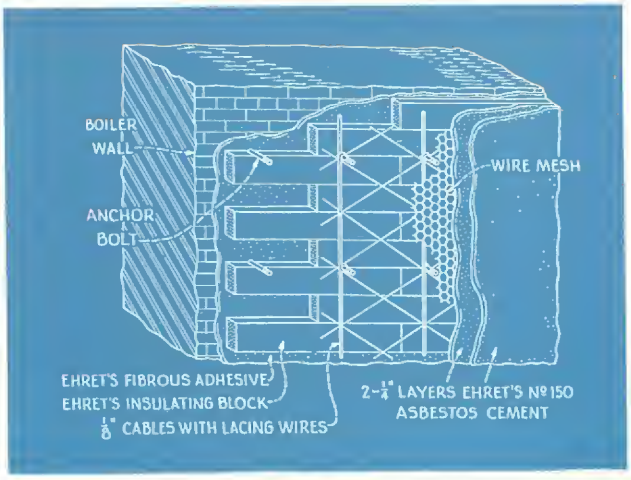


Fig. 16

Wall insulation should not be placed over any buckstays or supporting steelwork as these surfaces should be left exposed to prevent weakening by high temperatures. The blocks should be firmly secured with 1/8" wire cables stretched from provided anchors, and lacings of No. 16 gauge annealed iron wire. In locations likely to be subjected to occasional dampness, Copperweld wire should be used for lacing. Two-inch hexagonal mesh netting should then be stretched over and tightly fastened down with wires.

Cement Finish

A protective finish consisting of two layers of Ehret's No. 150 Asbestos Cement totalling at least 1/2" in thickness should be applied with the outer surface trowelled to a smooth, hard finish. If extra hardness is desired, the outer layer should contain 1/3 by weight of portland cement.

At all openings for doors, burners, etc., the insulation should be neatly bevelled down, finished clean, and the edges coated with Ehret's Emmco Refractory Cement 1/2" thick. (Fig. 17).

Panel Finish

Instead of the wire mesh and cement finish, a panel protection of Ehret's Pyroboard 3/8" thick may be bolted over the laced-on insulating blocks, using strap iron battens in accordance with the details suggested in Fig. 18.

BRICK-TYPE INSULATION

Materials

A brick-type insulation is sometimes required for structural reasons. In such cases Ehret's Durocel Insulating Brick of the proper grades to suit the temperature requirements should be used.

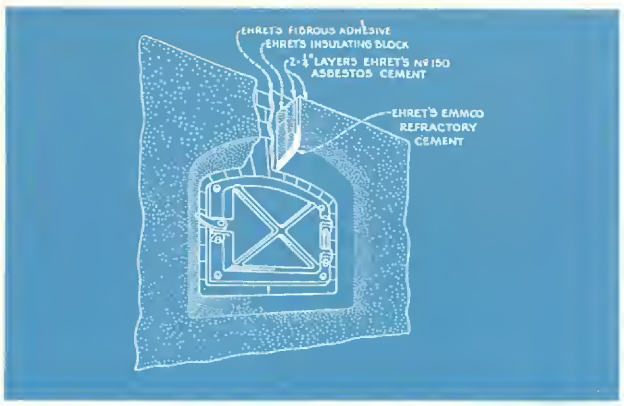


Fig. 17

Application—Boiler Tops

Ehret's Insulating Brick should be placed directly over the firebrick in a 4 1/2" thickness. (Fig. 19).

Smoothly stretch and firmly fasten 2" hexagonal mesh netting over the brick and then apply two layers of Ehret's No. 150 Asbestos Cement to a total of at least 1/2" thickness. If further protection from mechanical damage is desired, a course of common red brick may be laid directly on top of the cement finish, preferably while the last layer is still wet.

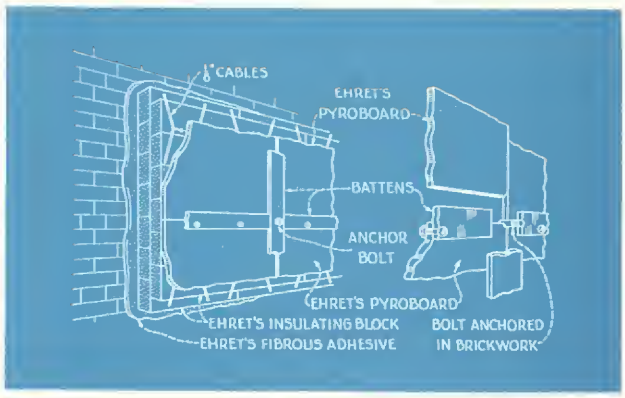


Fig. 18

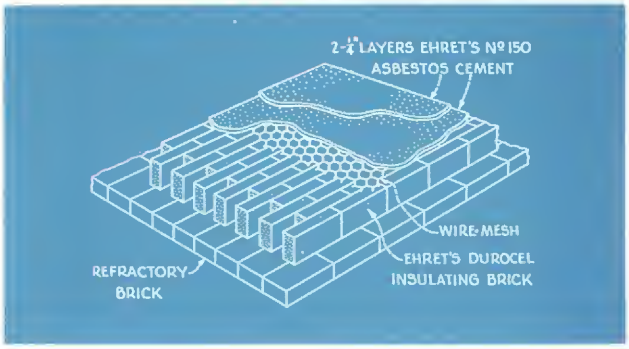


Fig. 19

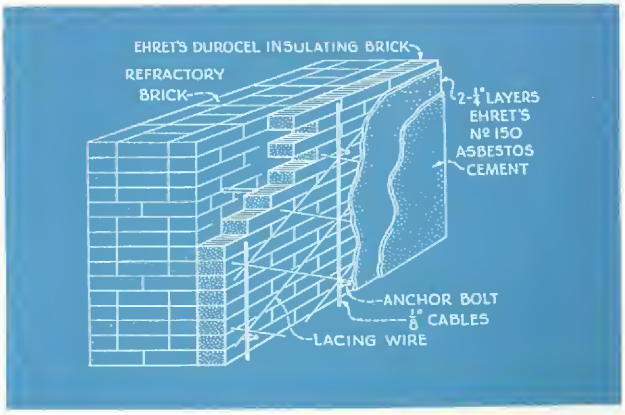


Fig. 20

lication—Existing Walls

pplying brick insulation to existing furnace a 4½" thick course of Ehret's Durocel lating Brick should be built up over the surface of the brickwork. (Fig. 20). course should be firmly fastened in place ⅛" wire cables attached to anchor bolts

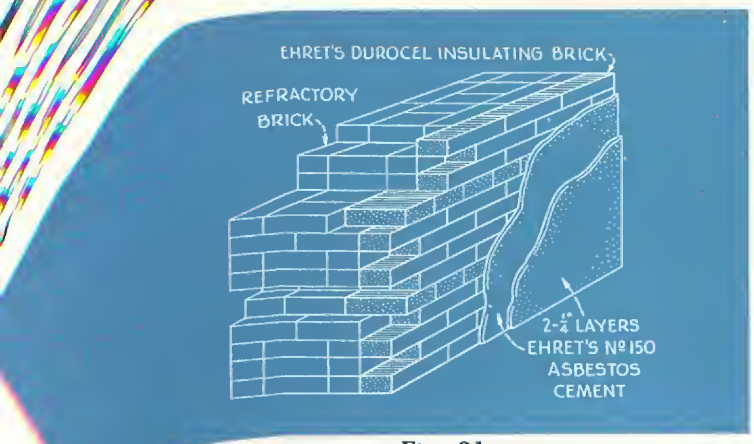


Fig. 21

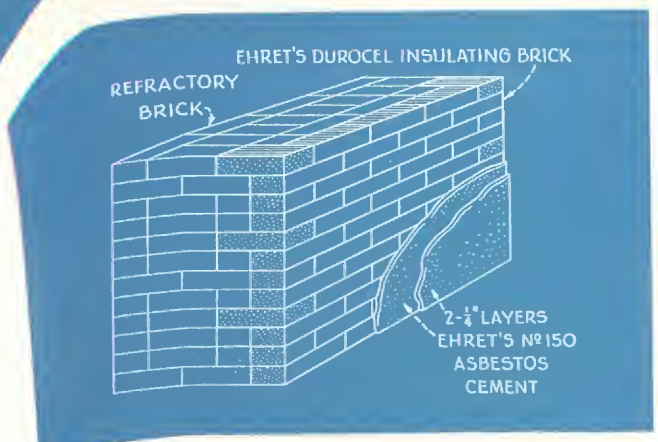


Fig. 22

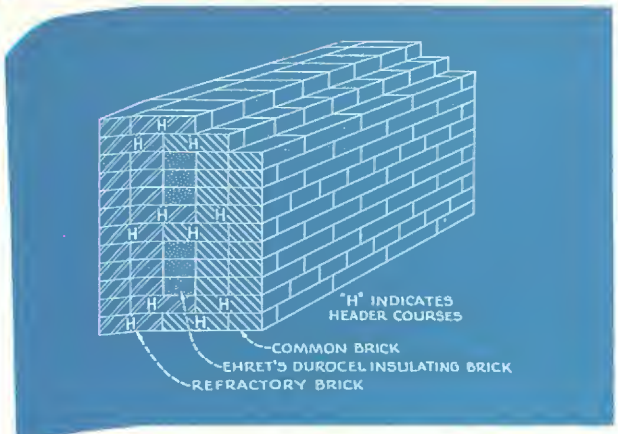


Fig. 23

placed at about 24" centers and further retained by means of No. 16 gauge annealed iron wire lacings. An exterior asbestos cement finish may then be provided in the same manner as that described for Block Type Insulation.

Application—New Walls

When a veneer type of insulating brick construction is desired, a 4½" thick course of Ehret's Durocel Insulating Brick should be built up with and bonded into the firebrick wall.

On the furnace walls, a course of insulating brick should be bonded into the firebrick at every fifth course. (Fig. 21). On other walls, the bonding is effected in a similar manner excepting that instead of a solid row of headers, there is one header placed in every fourth layer. (Fig. 22). An exterior cement finish may be provided in same manner as that described for Block Type Insulation.

Where insulating brick is to be used as a core in boiler wall construction, a 4½" thickness of Ehret's Durocel Insulating Brick should be built in between the firebrick and the red brick exterior, the three types of brick being bonded together.

At the combustion zones, the bonding is effected by solid courses of red brick and firebrick headers joined through the course of insulating brick at every fifth course. (Fig. 23). In the other walls, the bonding is obtained by joining two adjacent red brick headers and two adjacent firebrick headers through the insulating brick at every fifth course, with three insulating bricks horizontally between headers. (Fig. 24). In no case should the insulating brick be used as the bonding brick. The insulating brick should be laid up in Ehret's Durocel mortar with thinly rubbed joints and the outer red brick should be laid up in portland cement mortar.

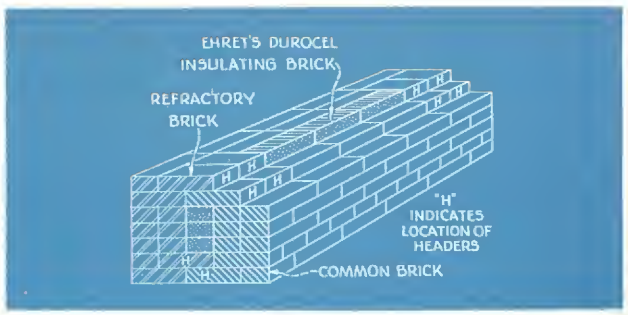
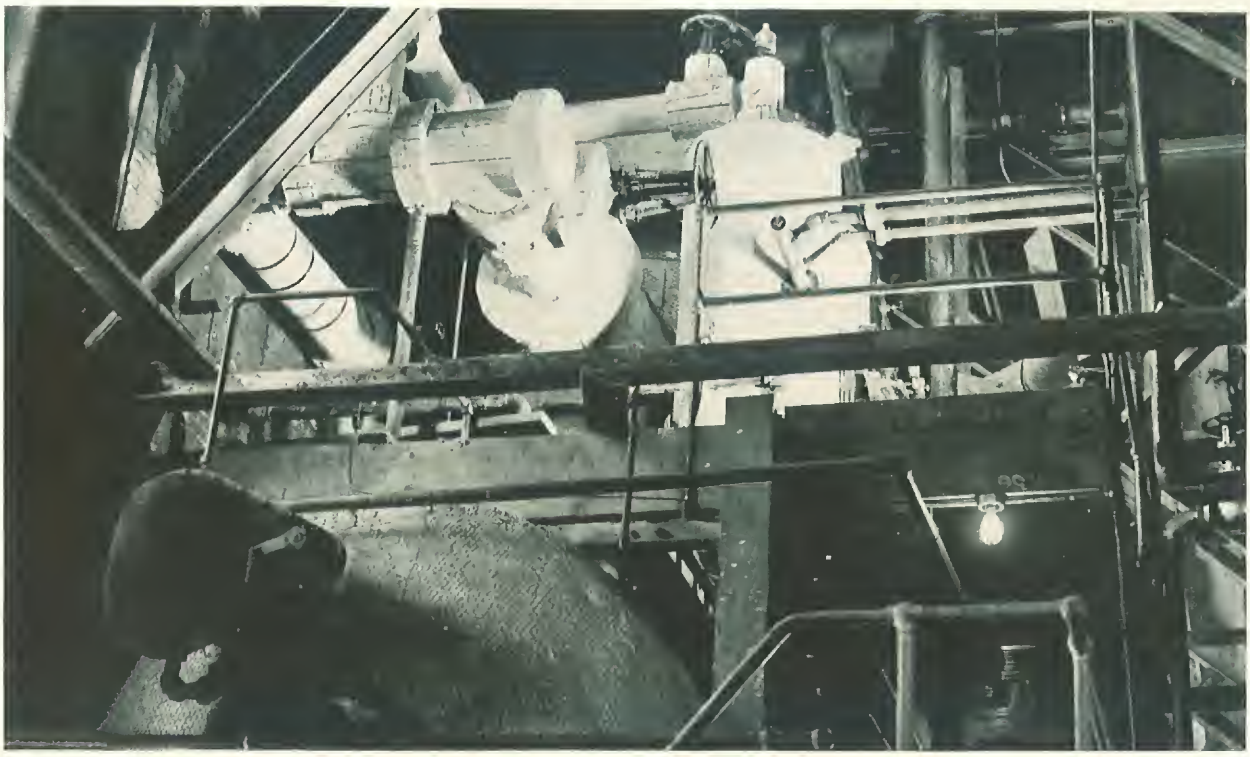
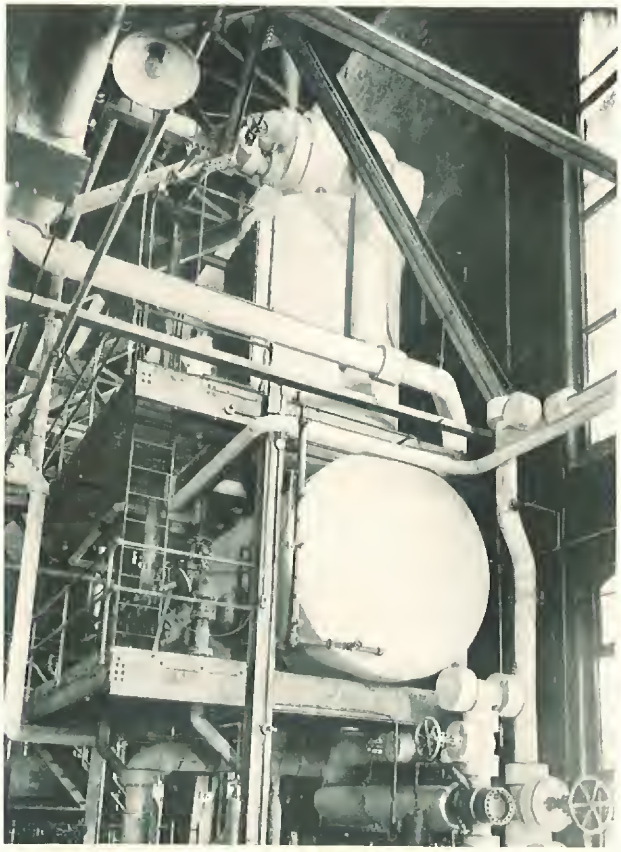


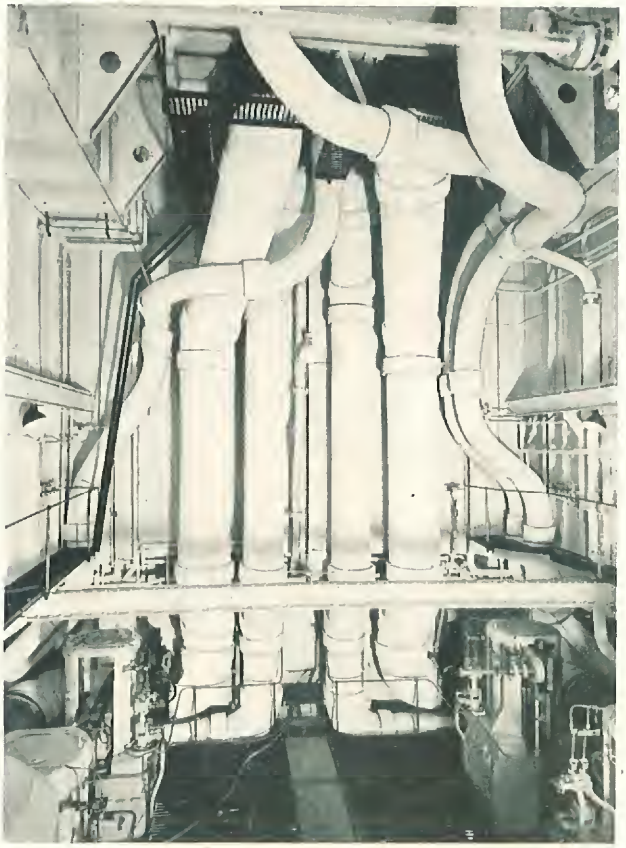
Fig. 24



Large flanged fittings in the power plant of a New England textile mill in the process of being covered with Ehret's 85% Magnesia blocks.



Feedwater tanks and piping covered with Ehret's 85% Magnesia blocks and pipe coverings.



Diesel engine exhaust pipes (36") insulated with Ehret's Enduro and 85% Magnesia segmental coverings. (1500° f.)

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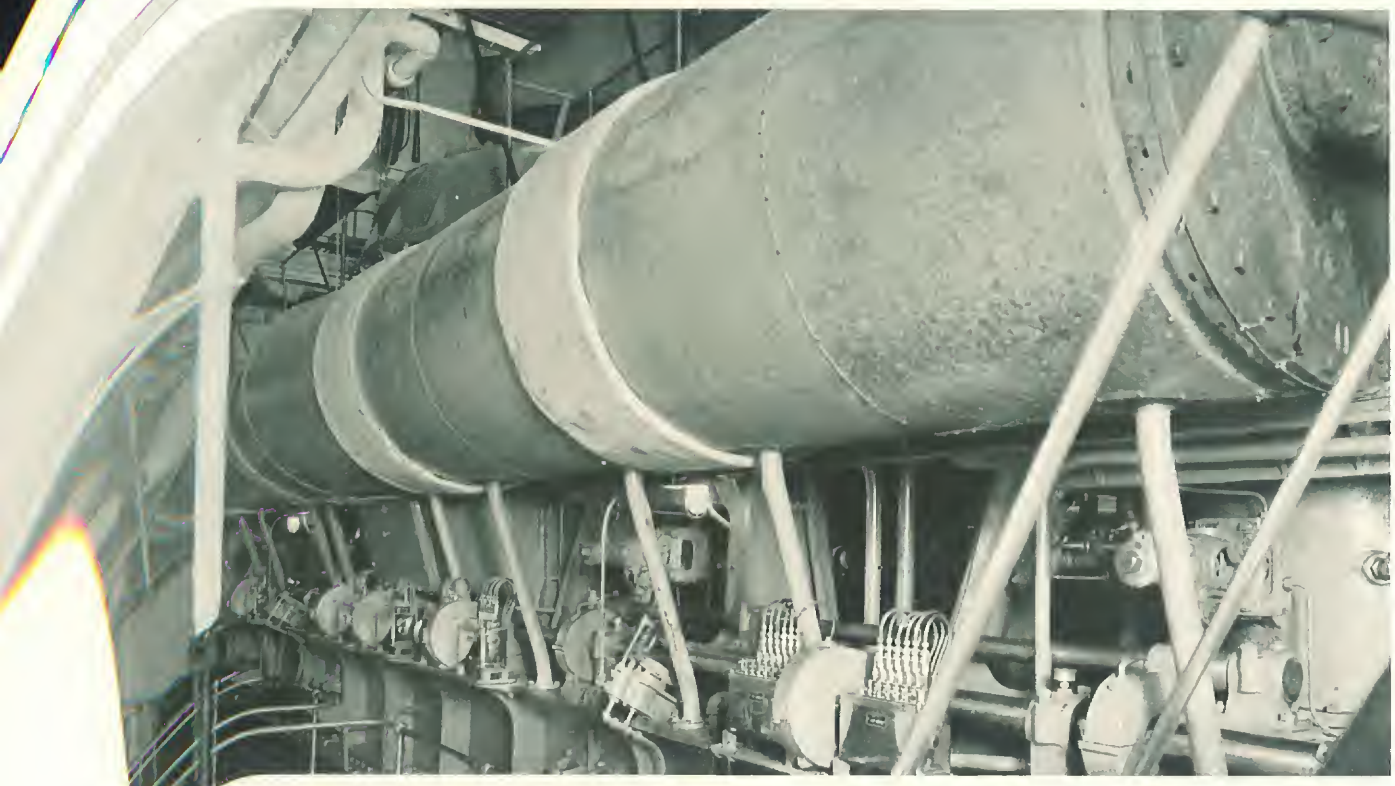
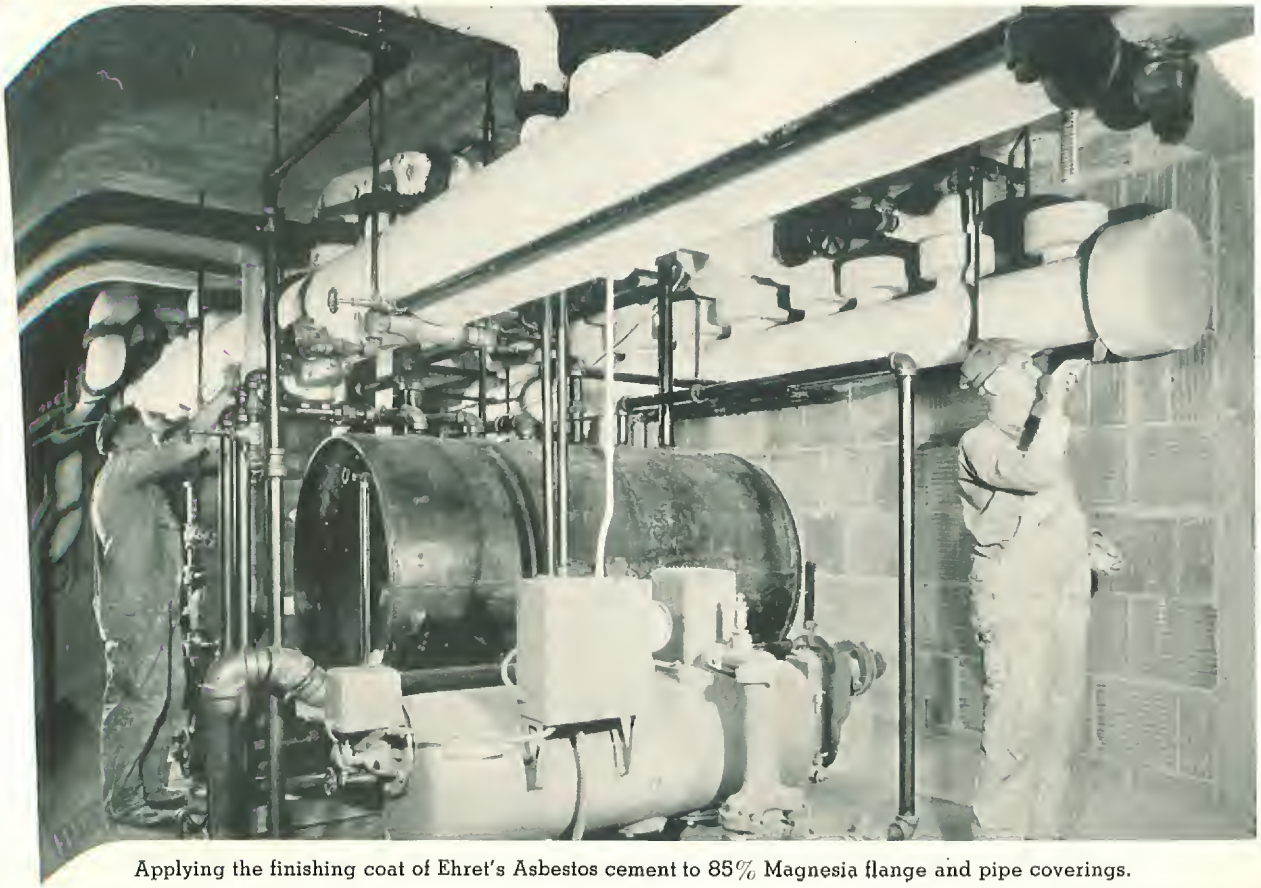


Main Exhaust belt, 48" in diameter, on a diesel engine . . . covered with Ehret's Enduro, 85% Magnesia and removable blankets over flanges.



Applying the finishing coat of Ehret's Asbestos cement to 85% Magnesia flange and pipe coverings.

EXPANSION JOINTS

In general boiler wall construction, expansion joints should be provided at proper locations. Suggested details for expansion joint construction are given in Fig. 25. The space in the expansion joints should be filled with Ehret's Asbestos Rope protected with Ehret's No. 18 Heat-Seal Insulating Cement.

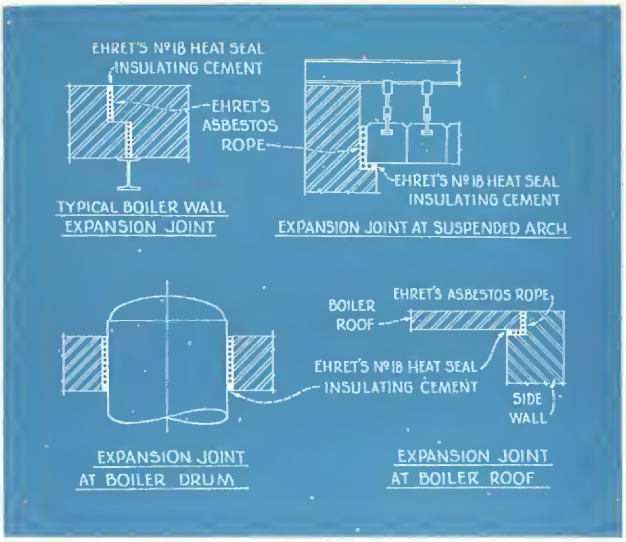


Fig. 25

BOILER BASES

It is good policy to insulate the bases of boilers, especially when there is a cinder fill, wood piling which might be charred, or adjacent steelwork which might be warped by the heat.

Where insulation is desired under the refractory of the boiler base, a layer of Ehret's Durocel Insulating Concrete 4" thick should be used. (Fig. 26). This is composed of a mixture of 4 parts of Ehret's Durocel Calcined Aggregate and 1 part of portland cement by volume, the damp mixture to be firmly tamped to make the layer thoroughly homogeneous. Expansion joints should be provided in boiler base insulation to prevent arching.

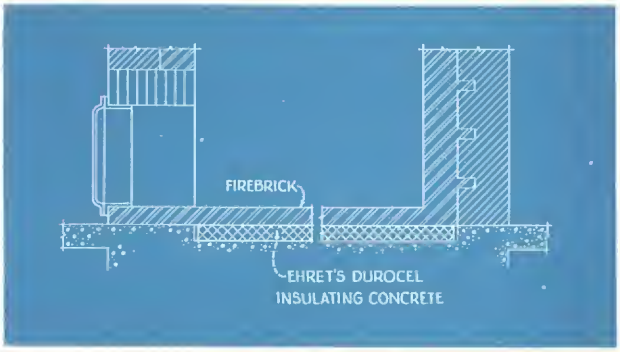


Fig. 26

BOILER SHELLS AND DRUMHEADS

Materials

On water-tube and horizontal-return-tube type boilers, all exposed metal surfaces of shells and drumheads should be insulated with Ehret's 85% Magnesia Block, or a combination of Ehret's Enduro Block and Ehret's 85% Magnesia Block, thicknesses to be in accordance with the following table:

Temperature of Hot Surface (in degrees F.)	Thickness	
	Enduro	85% Magnesia
Up to 300	....	1½"
301 to 400	....	2"
401 to 500	....	2½"
501 to 600	....	3"
601 to 700	1½"	2"
701 to 800	2"	2"
801 to 900	2"	2½"
901 to 1000	2½"	2½"
1001 to 1100	3"	2"

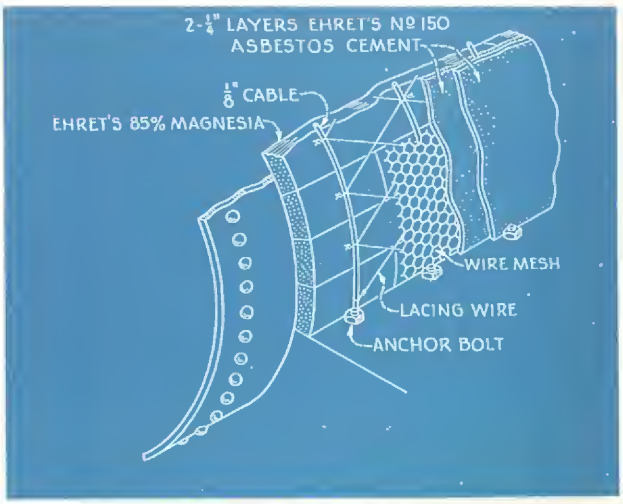


Fig. 27

Application

The blocks should be carefully fitted and placed against the steel surfaces. (Fig. 27). Where there are two layers of blocks all joints should be staggered and pointed up with Ehret's No. 150 Asbestos Cement. When a combination insulation is used, the Enduro Blocks should be applied as the inner layer. (Fig. 28).

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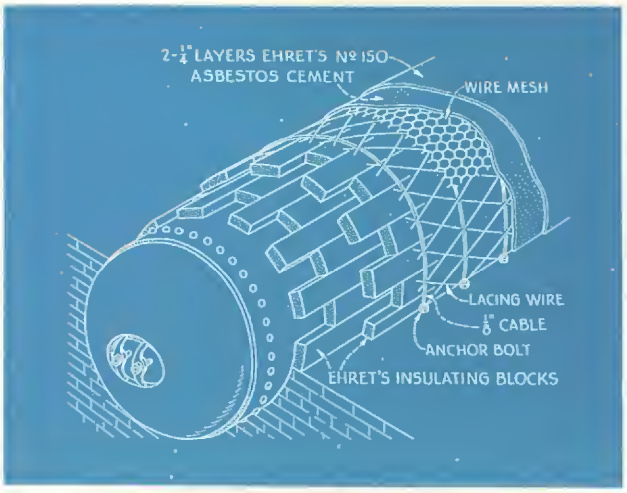

Fig. 28

The blocks should be held securely in place with No. 16 gauge annealed iron wire lacings between ⅛" wire cables drawn tightly from anchorages previously built into the brickwork by the setting contractor.

Securing the blocks to drumheads requires special care. Two ⅛" wire cables should be wrapped around the surface of the shell just back of the ring of rivet heads, with hairpin wires looped around the cables at close intervals and drawn outward to clear the brickwork. *This should be done by the setting contractor before the brick wall is built around the shell.* (Fig. 29).

While the insulating blocks are being applied, No. 16 gauge annealed iron lacing wires should be attached to the hairpin wires and drawn tight to a loop of wire cable close around the manhole opening, and Ehret's Fibrous Adhesive may be used to facilitate application of the insulating blocks. After the blocks have been completely wired into place, 1½" hexagonal mesh netting should be stretched tightly and fastened securely over the blocks. (Fig. 30).

Two layers of Ehret's No. 150 Asbestos Cement should then be applied over the blocks, to a total thickness of at least ½", with the outer layer trowelled firmly to a smooth, hard finish.

INSPECTION PLUGS

It is sometimes required that removable plugs be provided in the insulation for rivet inspection. Such openings should be about 6" by 9" and they should be spaced and located in accordance with the requirements.

The openings in the insulation should be given slightly tapered sides, so that the tapered plug can be easily inserted and removed, and the edges of the insulation should be lightly trowelled over with Ehret's No. 150 Asbestos Cement. The plug of insulation can be made by shaping a piece of insulating block of the proper thickness so that it will fit snugly into the opening. A piece of 8 ounce canvas about 12" x 15" pasted down onto the plug and adjacent covering will serve to hold the plug in place.

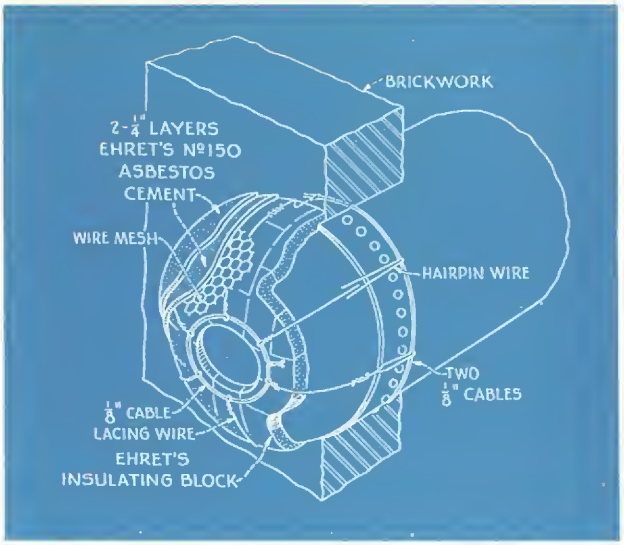

Fig. 29

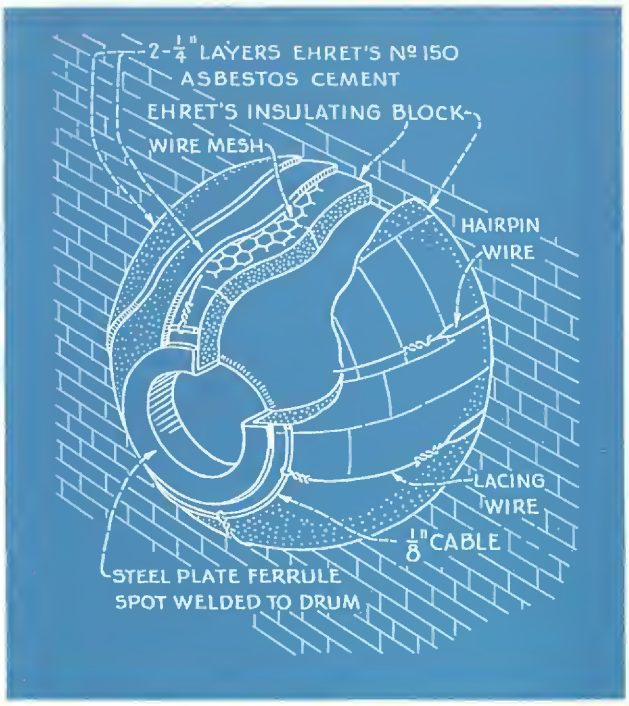

Fig. 30

BOILER TUBE DOORS

Recessed doors may be insulated on the inside with Ehret's Durocel Insulating Concrete. A sufficient number of substantial anchor bolts should be provided, the bolt heads projecting into the recess three-quarters of the depth to be filled. The doors should be laid flat and the Durocel Insulating Concrete poured and tamped into the recess to the required depth. (Fig. 31).

For flat doors or doors having insufficient depth of recess to hold insulating concrete, the insulation should consist of Ehret's Asbestofibre Felted Sheets 2″ thick. The exposed surface of the insulation should be protected with Ehret's Pyroboard ¼″ thick, and a sufficient number of bolts should be provided through the complete assembly to hold the insulation securely in place.

FIRE BOX AND CAST IRON SECTIONAL BOILERS

Materials

The outer surfaces should be insulated with Ehret's 85% Magnesia Block. Where the temperature is under 300° F. the blocks may be 1½″ thick, and for temperatures from 300° F. to 400° F. the blocks should be 2″ thick.

Application

When a cast iron sectional boiler presents corrugated surfaces they should be given a trowelled-on coat of Ehret's 85% Magnesia Cement to provide a level surface. The insulating blocks should then be applied directly to the dry cement surface. When metal surfaces are relatively flat the insulating blocks may be held in place with a coating or spotting of Ehret's Fibrous Adhesive.

Blocks should then be secured with ⅛″ wire cables looped over the boiler and attached to anchors or a loop of ⅛″ wire cable drawn tightly around the base. No. 16 gauge annealed iron wire should be closely laced between the cables to draw them tight. (Figs. 32 and 33).

Over the wired-on blocks, 2″ hexagonal mesh netting should be stretched and firmly attached. A protective finish should be applied over the netting, this finish to consist of two layers of Ehret's No. 150 Asbestos Cement to a total thickness of at least ½″, with the outer layer firmly trowelled to a smooth, hard surface. Portland cement ⅓ by weight may be added to the outer layer if an extremely hard finish is desired. It is advisable in most cases to paste 6 ounce canvas onto the surface of the finish coat, to prevent small shrinkage cracks.

Special care should be taken with the edges of the insulation around all openings. These should be neatly bevelled and the construction made extra smooth and secure to prevent loosening of, or damage to, the insulation.

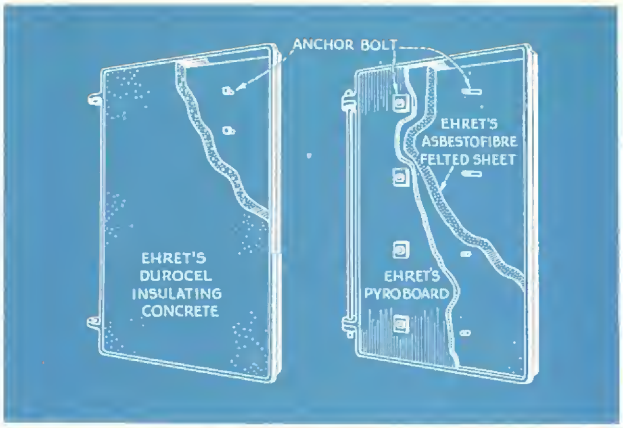

Fig. 31

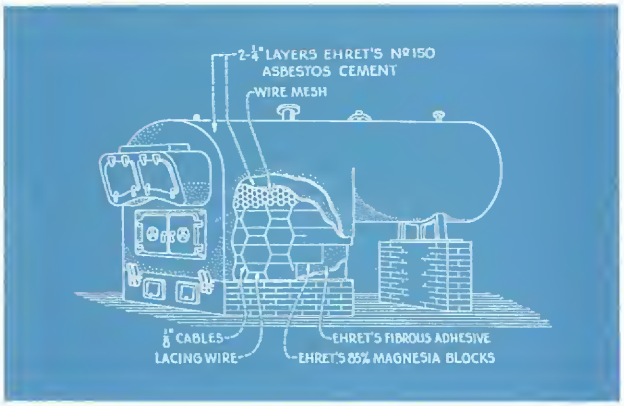

Fig. 32

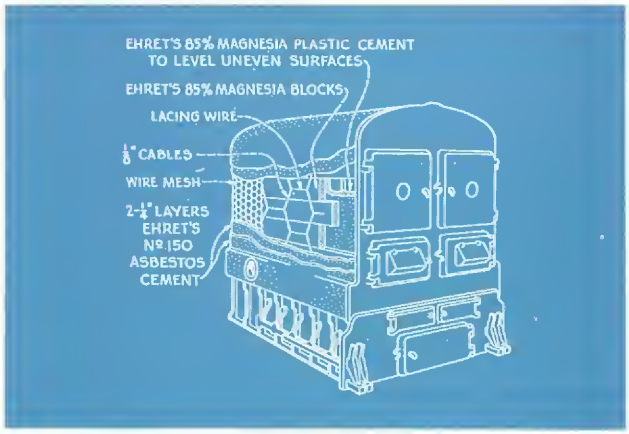

Fig. 33

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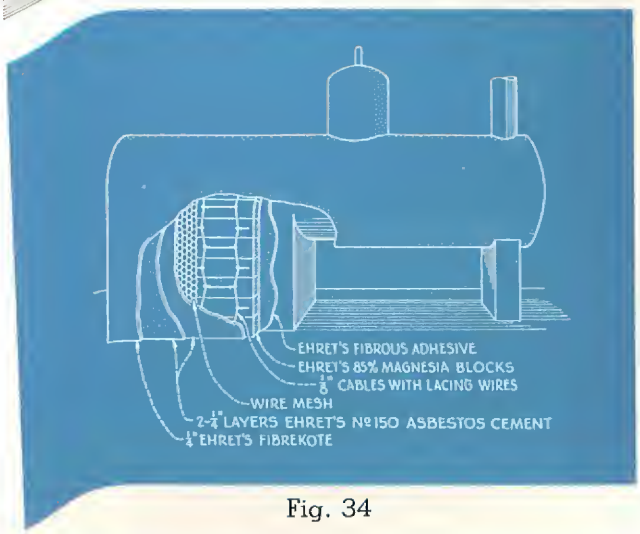


Fig. 34

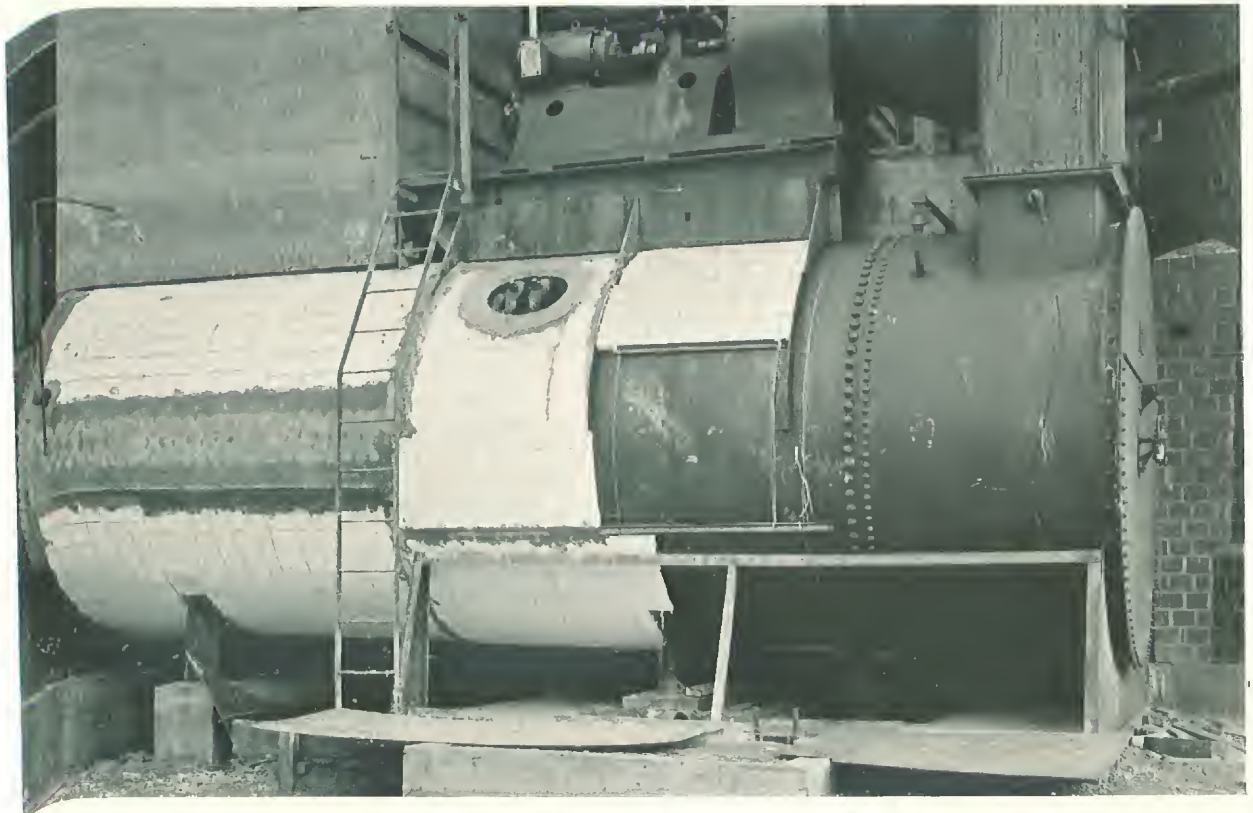
OIL FIELD BOILERS

A satisfactory insulation for oil field boilers consists of Ehret's 85% Magnesia Block 1½" thick. It should be attached to the steel surfaces with Ehret's Fibrous Adhesive and then permanently secured in place with ⅛" wire cables and No. 16 gauge Copperweld wire lacings between cables. Two-inch hexagonal mesh netting should then be smoothly stretched over the surface and firmly fastened with wires. (Fig. 34).

Over the wire mesh, two coats of Ehret's No. 150 Asbestos Cement to a total thickness of at least ½" should be applied, with the outer layer trowelled firmly to a smooth hard finish. After the last coat of cement is dry, the insulation should be weatherproofed with Ehret's Fibrekote, at least ¼" thick. This is to be thoroughly trowelled on and finished to a smooth surface, care being taken that the Fiberkote covers all projecting wires.

WASTE HEAT BOILERS

For economical and satisfactory operation, waste heat boilers must be protected with proper insulation. The entire flue system from the heating equipment to the waste heat boiler should be equally well insulated so as to prevent unnecessary heat loss. The waste heat boilers should be insulated in the same manner as ordinary boilers, while flues and ducts should be insulated as described for Breechings and Ducts. (Sheet No. 411.)



Ehret's 85% Magnesia blocks 2" thick wired in place on the surface of a waste heat boiler, in a plant of the Racine Gas Co., Racine, Wis.

ROUND BOILERS

A proper insulation for vertical round boilers consists of Ehret's 85% Magnesia Block 1" thick, placed directly against the metal surface and drawn up tightly by means of ⅛" wire cables with 2" hexagonal mesh netting smoothly stretched over the outer surface of the blocks and securely fastened with wires. (Fig. 35.)

The finish should be two layers of Ehret's No. 150 Asbestos Cement, applied to a total thickness of at least ½". For an extremely hard finish, ⅓ by weight of portland cement should be added to the outer layer. It is nearly always advisable to paste 6 ounce canvas over the asbestos cement finish, to prevent small shrinkage cracks.

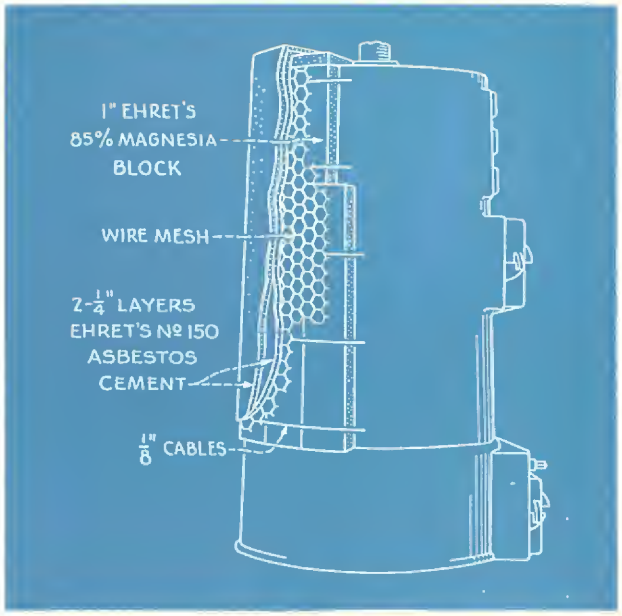


Fig. 35

HOT AIR FURNACES AND PIPES

Materials

The sheet metal casing which encloses the air passage around the furnace should be covered with Ehret's 85% Magnesia Block 1" thick. The hot air pipes which are not concealed in walls, etc., should be covered with Ehret's Corrugated Asbestos Paper to a total thickness of ½".

Application

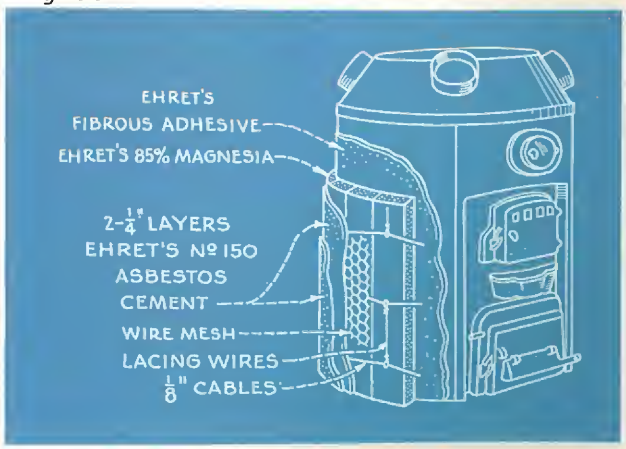
The 85% Magnesia Block should be held in place against the metal surface with Ehret's Fibrous Adhesive, then ⅛" wire cables should be looped around and drawn tight with No. 16 gauge annealed iron wire lacings. Two-inch hexagonal mesh netting should then be stretched tightly over the surface of the blocks with all edges carefully secured with wire. (Fig. 36.)

A typical example of a domestic heating boiler and pipes, covered with Ehret's 85% Magnesia blocks and pipe coverings.

Fig. 36

Two layers of Ehret's No. 150 Asbestos Cement totalling at least ½" in thickness should be applied over the wire netting with the surface firmly trowelled to a smooth, hard finish. It is usually desirable to paste 6 ounce canvas over the cement finish to prevent surface cracks.

All hot air pipes which are not concealed should be covered with two wrappings of Ehret's Corrugated Asbestos Paper ¼" thick, fastened on with separate loops of No. 16 gauge copper wire at 6" spacings. The ends of all wire loops should be firmly twisted together with pliers and carefully bent down to avoid projections. A jacket of 6 ounce canvas should then be pasted smoothly over the surface.



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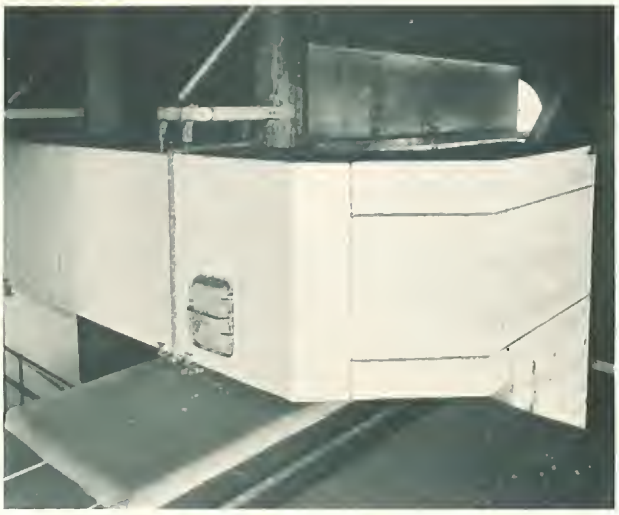
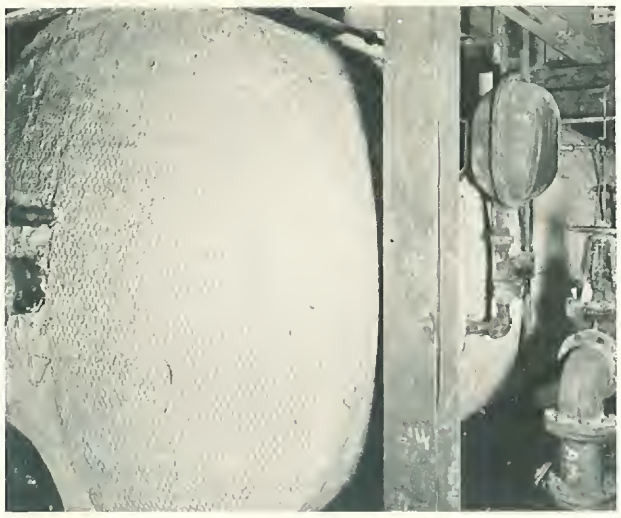
Connery Flue being insulated with Ehret's 85% Magnesia Block, 2½" thick.



The same flue shown at the left after the finishing coat of Ehret's No. 150 Asbestos Cement has been applied.



(Left). Feedwater storage tank in a textile mill showing wire mesh over blocks to hold finishing coats of Ehret's Asbestos Cement.

Steel stack-breeching insulated with Ehret's Enduro blocks and weatherproofed with trowelled-on coats of Ehret's Fibrekote.

BOILER AND ENGINE ROOM EQUIPMENT

BREECHINGS AND DUCTS

INSIDE LINING

Materials and Application

Anchors for the wires used to support the lining should be provided on inside surfaces. These anchors may consist of angle clips with holes punched through one leg, small nuts, etc. On the inside of the top of the duct the anchors should be spaced at 12″ intervals, both directions. On vertical sides, anchor spacings should be 24″ in both directions, while no anchors are necessary for the bottom.

Hook a No. 14 gauge annealed iron wire hairpin 6″ long through each anchor for use in securing the wire mesh. (Fig. 37.) Apply a layer of Ehret's Enduro Block 2″ thick to all inside surfaces, sticking blocks in place against the surfaces with a coating of Ehret's Fibrous Adhesive, with the hairpin wires extending out through the cracks between the blocks.

Fasten the blocks firmly in place with No. 14 gauge annealed iron wire stretched between and fastened to the hairpin wires, and then lay 1″ hexagonal mesh netting over the blocks and draw up tightly and secure to the wires.

Two coats of Ehret's No. 119 Semi-Refractory Cement totalling at least ¾″ in thickness should then be applied, the final coat to be trowelled extra smooth to provide a smooth passage for the moving gases.

OUTSIDE COVERING

Materials and Application

The insulation on the outside of a flue, breeching or duct should be applied over an air space to prevent concentration of heat at the metal surface with consequent scaling or disintegrating of the metal. The depth of the air space will depend on the construction of the steelwork of the breeching. In case the surface has closely-spaced projecting angles or ribs, metal strips or heavy iron wire fabric should be attached directly on the projections or ribs, to form the air space. Where flat surfaces are large enough, V-rib metal lath should be fitted and fastened over the surfaces by means of cables and wires. (Fig. 38.)

Where temperatures will not exceed 600° F., a layer of Ehret's 85% Magnesia Block 2″ thick should be applied over the air space. For higher temperatures a layer of Ehret's Enduro Block 2″ thick should be used. After the insulating blocks are thoroughly wired into place, 2″ hexagonal mesh netting should be tightly stretched over the entire surface and firmly fastened down. The finish should consist of two coats of Ehret's No. 150 Asbestos Cement totalling at least ½″ thick with the outer coat firmly trowelled to a smooth, hard surface. Portland cement ⅓ by weight should be mixed in the final coat if extra hardness is desired.

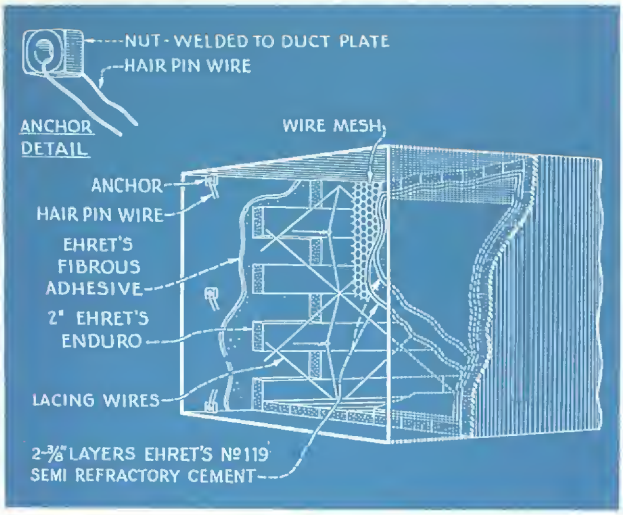


Fig. 37

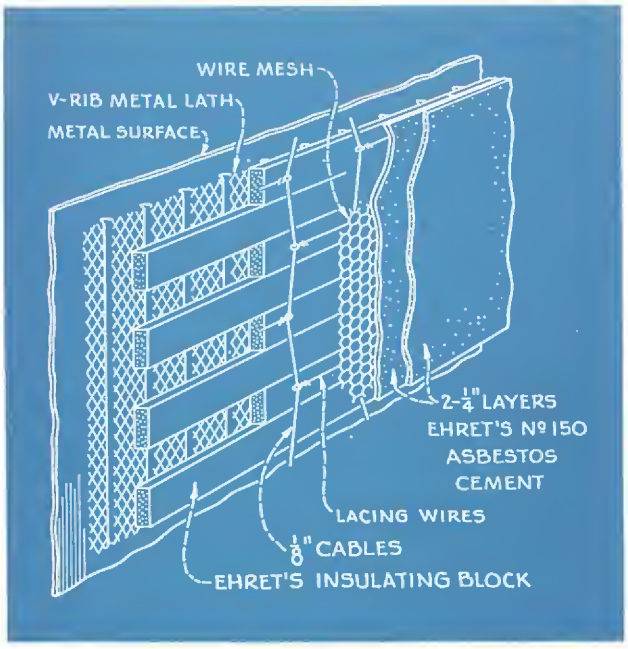


Fig. 38

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ASH PITS

For protecting ash pits a brick-type of insulation is usually required. Two layers of Ehret's Durocel Insulating Brick totalling 4½" thick should be laid over the inside surface of the casing. The refractory lining may then be built over the insulating brick in the usual manner. (Fig. 39.)

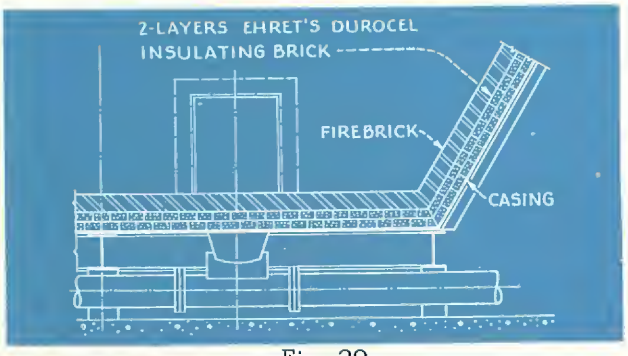


Fig. 39

STEEL STACKS

If an insulating lining is not provided in steel stacks, the inner surfaces will be corroded by acid condensation from the chilled flue gases, the life of the stack being considerably shortened. Proper inside insulation protects the steel and preserves the heat in the flue gases with a resulting better draft through the furnace.

Materials

Because of their service durability, Ehret's Fyrbestos Sheets 2" thick are best suited for most stack conditions. Where especially high insulating efficiency is desired, Ehret's Vitrified Asbestofibre Felted Sheets 2" thick should be used.

Application

The entire inner surface of the steel stack should be lined with the curved insulating sheets supported on 1½" x 1½" x 3/16" angle iron rings previously installed on the inside surface of the stack at intervals of 36½". The outstanding legs of these angle iron rings should have ⅜" holes punched near the outer edge at 12" spacings. Bent 5/16" bolts should be hooked through the holes and as the insulating sheets are fitted into place, 4" x 4" x ⅛" steel plate washers are to be placed over the bolts and drawn down tightly with nuts. Projecting bolt-ends should then be clipped off close. (Fig. 40.)

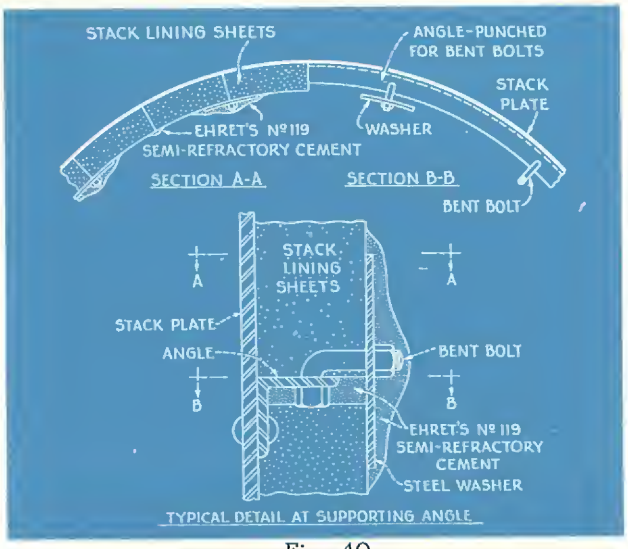


Fig. 40

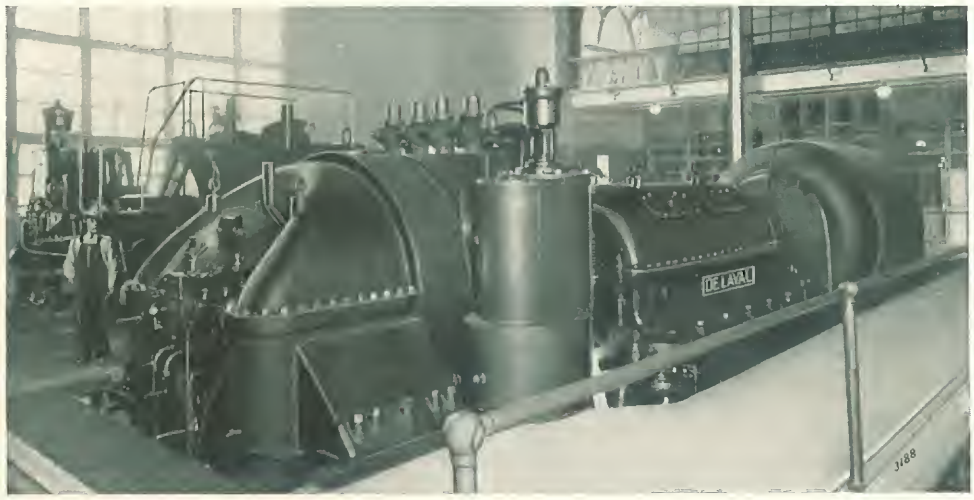
All joints and openings should be filled with, and all bolts and washers completely covered with Ehret's No. 119 Semi-Refractory Cement.

At the top of the stack a suitable cap should be provided to prevent entrance of moisture into the lining. This cap may be an angle iron ring tightly riveted to the top of the stack, or a weathertight, non-corroding, sheet metal flashing.

Where unlined portions of a steel stack are contained within a building, the outer surface of the stack should be insulated to prevent undesirable room temperatures. For this purpose, Ehret's 85% Magnesia Block 2" thick should be applied over a ¾" V-rib metal lath, in a similar manner to that described for Outside Covering of breechings and ducts.

The Cos Cob power plant of the N. Y., N. H. & H. RR. relies on Ehret Insulations for fuel economies

A DeLaval geared steam turbine that drives a 5000 KW alternator. Removable insulation is covered with neatly-fitted sheet metal jackets.



TURBINES

It is important that all heated surfaces of steam turbines, such as casings, chests, etc., should be thoroughly insulated to prevent loss of heat with subsequent condensation. Wet steam results in power losses, unnecessary wear and possible damage to the turbine itself. Three types of turbine insulation are described below.

BLOCK INSULATION

Materials

The first recommendation is to insulate with Ehret's 85% Magnesia Block or a combination of Ehret's 85% Magnesia Block and Ehret's Enduro Block in accordance with the following table:

Temperature of Hot Surface (in degrees F.)	Thickness	
	Enduro	85% Magnesia
Under 300	....	1½"
301 to 400	....	2"
401 to 500	....	2½"
501 to 600	....	3"
601 to 700	1½"	2"
701 to 800	2"	2"
801 to 900	2"	2½"
901 to 1000	2½"	2½"

Application

Anchors should be welded to casing on 18" centers where necessary. All irregularities of the turbine surface should be filled and leveled over smoothly with Ehret's 85% Magnesia Cement for temperatures not over 600°F., or with Ehret's Enduro Cement if the temperatures are above 600°F. The blocks should be carefully fitted and applied over the dry cement surface, and where there are double layers all joints should be staggered. Where a combination of Enduro and 85% Magnesia is used, the Enduro should be used as the inner layer. The blocks should be secured with ⅛" wire cables and No. 16 gauge annealed iron wire lacings. All crevices and joints should be neatly filled and pointed up with Ehret's No. 150 Asbestos Cement. (Fig. 41.)

Over the blocks 1" hexagonal mesh netting should be neatly fitted and tightly secured with wires. Then, two layers of Ehret's No. 150 Asbestos Cement totalling ½" thick are to be thoroughly trowelled on to provide a smooth, hard surface. If an extra hard finish is desired, portland cement ⅓ by weight should be mixed with the last layer.

All connections, flanges, valves, etc., on turbines should be insulated with the same material and to the same thickness as that on the surface of the turbine. The finish should be similar to that applied on the turbine insulation, as described above.

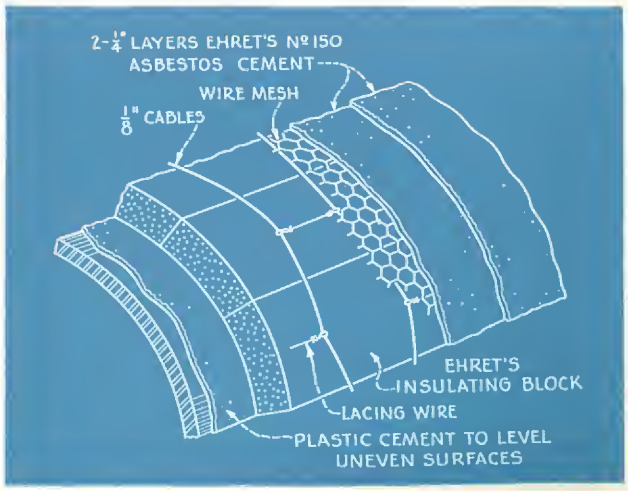


Fig. 41

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Where it is desired to further protect the insulation from damage, galvanized sheet metal casings fitted closely over the surfaces of the insulation, should be provided.

BLANKET INSULATION

Materials and Application

Certain sections of turbines such as control valve bonnets, flanges between casing sections, etc., require an easily removable-and-replaceable type of insulation. For this purpose, Ehret's Asbestos Blanket Insulation is recommended.

Consisting of amosite asbestos fibres quilted between asbestos cloth covers, these removable blankets are completely finished units that are custom made to proper dimensions, shapes and thicknesses for the conditions required. Sketches or blueprints together with full information as to temperatures and other requirements must be submitted for design and fabrication.

MONOLITHIC TYPE INSULATION

Materials and Application

Where a monolithic type of insulation is required, Ehret's No. 18 Heat-Seal Insulating Cement should be applied to the same total thicknesses as recommended for insulating blocks. The application should be in successive ½" layers, permitting each to dry before applying the next.

Over the last layer of insulation, 1" hexagonal mesh netting should be smoothly stretched and secured with No. 16 gauge Copperweld wire lacings. A finish consisting of two layers of Ehret's No. 150 Asbestos Cement totalling at least ½" thick should then be trowelled on firmly and smoothly, care being taken that all metal projections are completely covered.

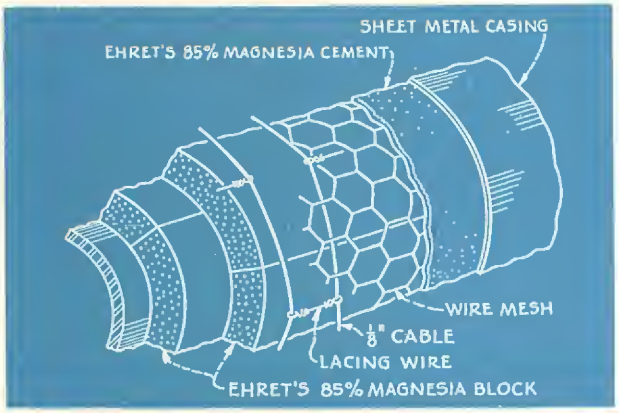


Fig. 42

RECIPROCATING ENGINES

Materials

High-pressure cylinders and valve chests should be insulated with Ehret's 85% Magnesia Block 3" thick, applied in two 1½" layers. For low-pressure cylinders and valve chests the insulation should consist of Ehret's 85% Magnesia Block 2" thick, applied in a single layer.

Application

The blocks should be carefully fitted to the metal surfaces and where there are two layers, all joints should be staggered. The blocks should be firmly fastened in place with ⅛" wire cables and No. 16 gauge Copperweld wire lacings. All joints should be neatly pointed and smoothed down with Ehret's 85% Magnesia Cement. (Fig. 42.)

Over the block surface 2" hexagonal mesh netting should be smoothly fitted and firmly secured with wire. A layer of Ehret's 85% Magnesia Cement just thick enough to completely cover the netting and tie wires should be trowelled on smoothly. A protective sheet metal casing should then be fitted and fastened into place over the insulation.

MISCELLANEOUS EQUIPMENT

Materials and Application

The insulation of miscellaneous equipment such as ash hoppers, settling chambers and connections, induced draft housings and ducts, should be the same in materials, thicknesses, and application as described for Outside Covering of Breechings and Ducts. (Sheet No. HCI 411.)

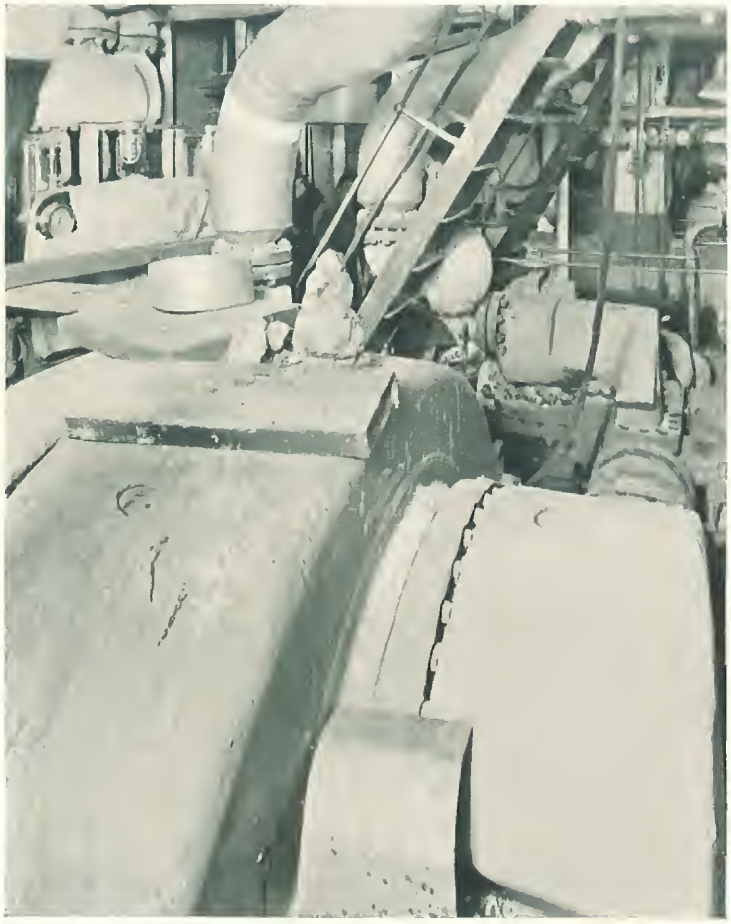
(Left) A soot hopper bottom being insulated with Ehret's Enduro blocks 1" thick and 85% Magnesia blocks 2" thick.

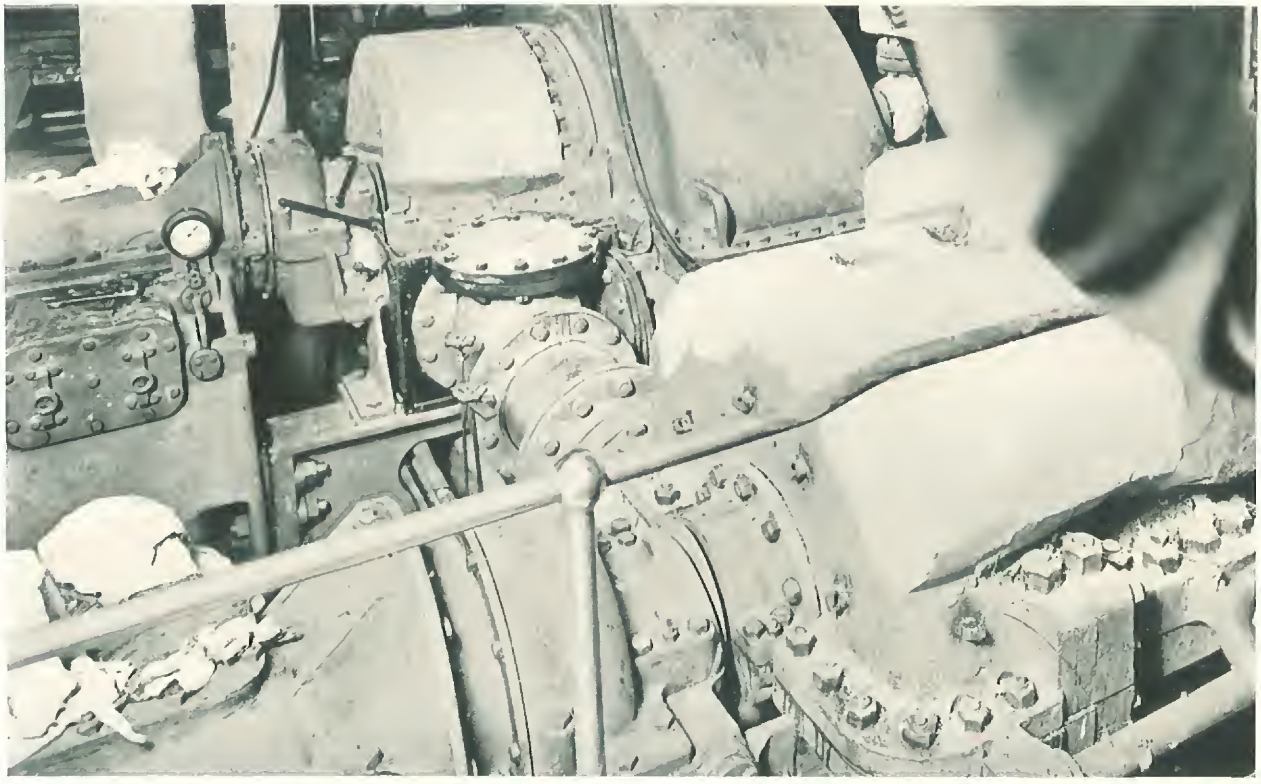
Main Propelling Turbines on the "S. S. ASSOCIATED"

TURBINE INSULATION in the process of application to casings, pipes and fittings.

These 3600 H. P. turbines receive steam at approximately 700° throttle temperature. Insulation consists of Ehret's Enduro Block 1" thick securely wired in place and covered with ½" of Enduro Cement. Over the Enduro is applied a layer of Ehret's 85% Magnesia Block 1½" thick, securely wired in place and trowelled with 85% Magnesia Cement ½" thick.

A metal jacket is supplied by the turbine manufacturer and will be installed after the insulation application has been completed. Sufficient 85% Magnesia Cement to completely fill irregular spaces within the jacket will be trowelled onto the surface of the insulation before the jacket is applied. Total insulation thickness is approximately 4 inches, and the jacket support consists of 3" x ¼" flat steel bars welded to the turbine casing.





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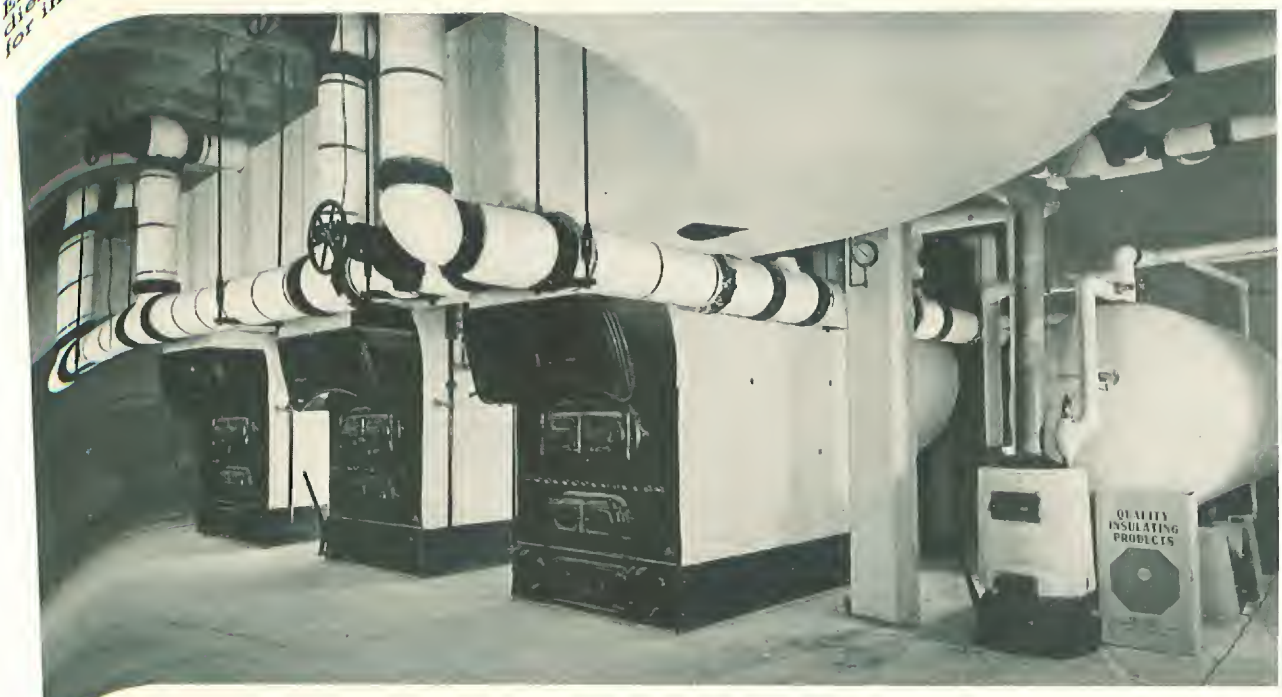
EHRET
INSULATIONS

Ehret Heat Seal Blanket insulation on an expansion joint in a diesel exhaust line. Copper wire lacings permit easy removal for inspection and servicing.

A 4-pipe reheater outlet in a large utility power plant being covered with Ehret's Enduro 2" thick, 85% Magnesia 2" thick and a trowelled-on layer of Fibrekote.



Boiler room in the U. S. Post Office at Peoria, Illinois. The boilers, breeching, hot water heater, storage tank and piping are covered with Ehret's 85% Magnesia.

AUXILIARY ENGINES AND EQUIPMENT

Heated surfaces of all auxiliary engines and equipment should be completely covered with insulation in order to minimize heat losses, steam condensation and overheating of rooms.

Materials

The insulation should consist of Ehret's 85% Magnesia Block or a combination of Ehret's 85% Magnesia Block with Ehret's Enduro Block, the thicknesses to be in accordance with the following table:

Temperature of Hot Surface (in degrees F.)	Thickness	
	Enduro	85% Magnesia
Under 300	....	1½"
301 to 400	....	2"
401 to 500	....	2½"
501 to 600	....	3"
601 to 700	1½"	2"
701 to 800	2"	2"
801 to 900	2"	2"
901 to 1000	2½"	2½"

Application

To facilitate application, the first layer of blocks may be attached to even metal surfaces with a thin coating of Ehret's Fibrous Adhesive. The insulating blocks are to be carefully fitted, and where two layers are applied joints should be staggered, and Enduro Blocks, when used, should be applied as the first layer. All crevices should be pointed up with Ehret's 85% Magnesia Cement and the blocks should be secured with ⅛" wire cables and No. 16 gauge annealed iron wire lacings. On the larger surfaces 2" hexagonal mesh netting, and on the smaller surfaces 1" hexagonal mesh netting, should be carefully fitted and tightly fastened in place with wires. (Fig. 43.)

Over the wire mesh two layers of Ehret's No. 150 Asbestos Cement totalling at least ½" in thickness, should be applied, with the outer surface trowelled to a smooth, hard finish. For extra hardness ⅓ by weight of portland cement should be added to the outer layer.

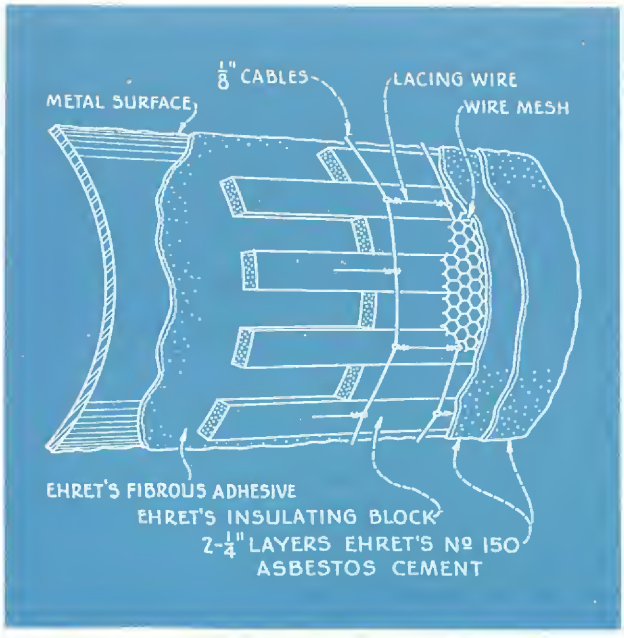


Fig. 43

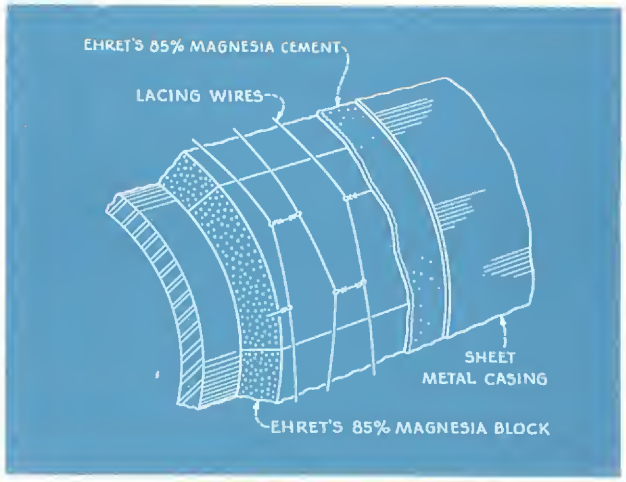


Fig. 44

HOT AND COLD PUMPS

Materials and Application

For permanent insulation, all steam and hot water cylinders and chests should be insulated with Ehret's 85% Magnesia Block 2" thick. The blocks should be accurately cut and fitted to the various surfaces and should be securely fastened in place with No. 16 gauge Copperweld wire wrapped around and cross laced. All joints are to be carefully pointed up and the entire surface trowelled smoothly with Ehret's 85% Magnesia Cement. Protective casings made of substantial sheet metal should then be closely fitted over the insulation and secured in a neat manner. (Fig. 44.)

Removable-type block insulation for pump heads and chests, can be constructed by carefully fitting and securing the blocks into metal forms or jackets, which should then be banded or bolted in place.

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EHRET
INSULATIONS

When an easily removable and replaceable type of insulation is required, Ehret's Blanket Insulation should be used. These blankets are designed for various temperatures and are custom made from sketches or blue prints of the equipment to be covered.

All cold water pumps and cold water meters should be insulated with Ehret's Standard Hair Felt to the same thickness as that of the insulation on the adjacent cold water piping. A coating of Ehret's Fibrekote at least ¼" thick should be trowelled into the surface of the hair felt to protect it from moisture. Sheet metal jackets should be provided as described for hot pumps.

FUEL OIL HEATERS AND PIPING

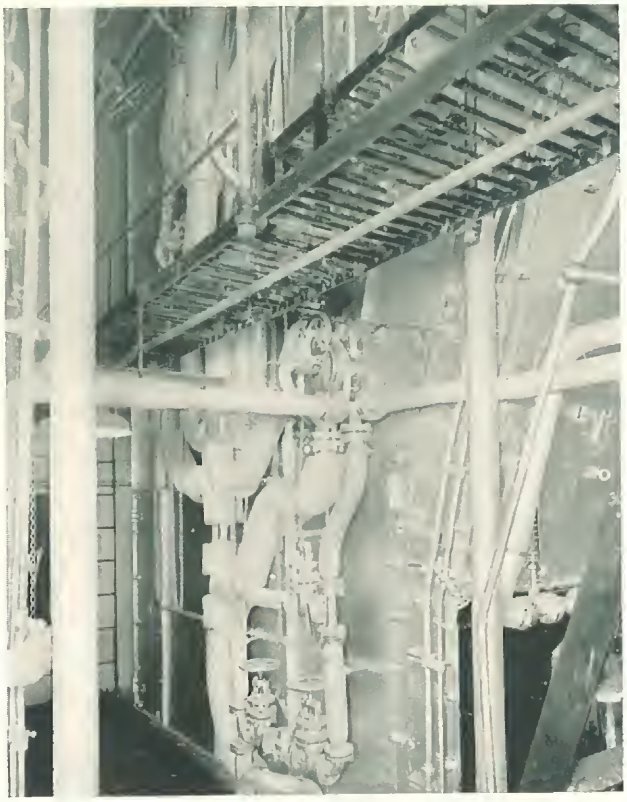
Proper insulation of fuel oil heaters and pipes reduces the amount of heat required to warm the oil and prevents sluggish flow.

Materials and Application

The fuel oil heater should be insulated with Ehret's 85% Magnesia Block 1" thick, wired securely on and finished with a layer of Ehret's No. 150 Cement, ¼" thick, trowelled smooth.

The fuel oil lines from the heater to the burners, and the surplus oil return lines should be insulated with Ehret's 85% Magnesia Pipe Covering, Standard Thick.

If a protective metal jacket is not required on the pipe insulation, an 8 ounce enamelling duck sewed jacket should be applied over a wrapping of 40 lb. rosin sized paper. This jacket should be stretched smooth and tight and sewed neatly and securely with seams located where least visible.



Soot blower lines and fuel oil piping covered with Ehret's 85% Magnesia.

The S. S. Seatrain New York, 10,900 tons, has 1200 lb. working pressure boilers and 8800 H. P. turbines protected with Ehret insulations. Ehret-insulated refrigeration equipment cools the 100 refrigerator cars which it carries.

CEILING INSULATION

Materials

The ceilings over boilers, furnaces, ovens, etc., should be insulated to prevent heat from penetrating upward. The insulation should consist of Ehret's 85% Magnesia Block from 2″ to 3″ thick, according to conditions.

Application

Where the construction of the ceiling permits, the insulation may be attached directly to the ceiling surface. If beams or other irregularities of the ceiling make direct application impracticable, suspended structures should be built and the insulation attached thereto.

Where the insulation can be directly applied to the surface of the ceiling, the blocks should be attached by means of a coating of Ehret's Fibrous Adhesive. Anchor bolts should be previously fastened into the ceiling on 12″ x 18″ centers and should be of such a length as to extend downward between the blocks far enough for 4″ x 4″ x ⅛″ plate washers and nuts. (Fig. 45.)

One inch hexagonal mesh netting should be stretched over the blocks and held tightly in place with the steel plate washers on the anchor bolts. As a finish, two layers of Ehret's No. 150 Asbestos Cement of sufficient thickness to cover all metal projections should be firmly trowelled on, the outer surface to be hard and smooth.

Where suspended framework is required to support the insulation, angle iron frames should be hung from the ceiling or the beams by strap iron hangers, preferably dropping down far enough to clear the beams. Two light-weight angles about 1½″ x 1½″ x 3/16″ should be bolted back-to-back with strap hangers between, using ¼″ bolts. In all cases, the angles should be spaced 36½″ apart in one direction and at six foot intervals in the other direction, thus permitting 36″ blocks to be placed across with ends supported on top of the horizontal legs of angles. (Fig. 46.)

Just before the blocks are put in position, three ¼″ pencil rods, 6½ feet long, should be placed at right angles to the length of the blocks, resting the ends of the rods on top of the upright legs of those angles which are at the six foot spacings. These iron pencil rods should be installed with one rod in the middle of the ceiling panels and the other rods one foot on either side. A sufficient number of hairpin wires are to be hung from these rods so as to project through at every joint. The blocks are to be firmly fastened in place with No. 16 gauge annealed iron wires and 1″ hexagonal mesh netting drawn up with the hairpin wires. A cement finish should then be applied as described for blocks attached directly to the ceiling surfaces.

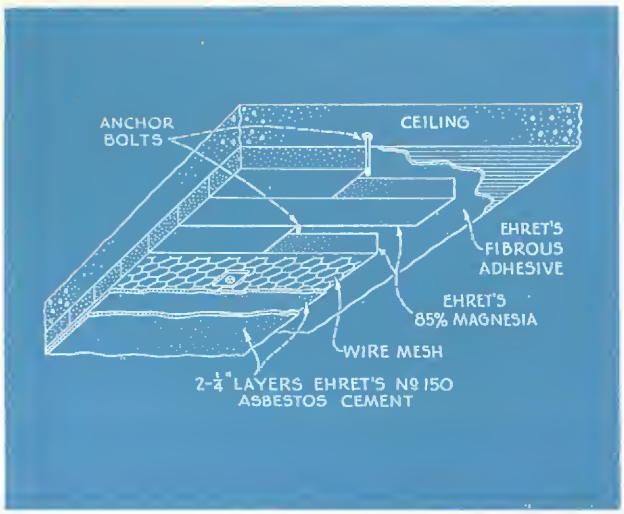


Fig. 45

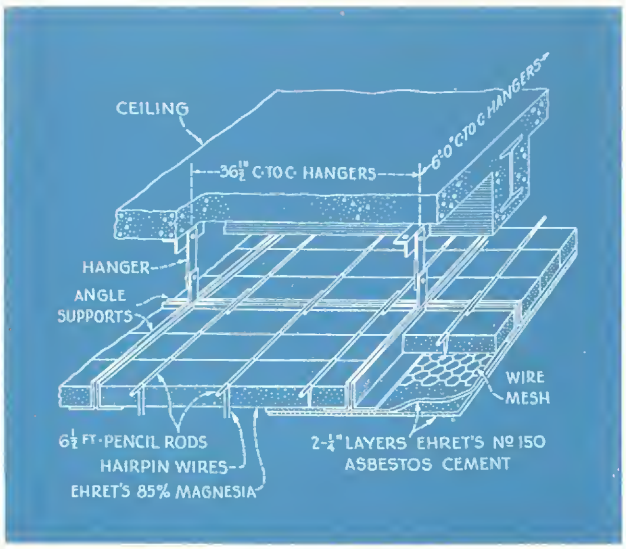
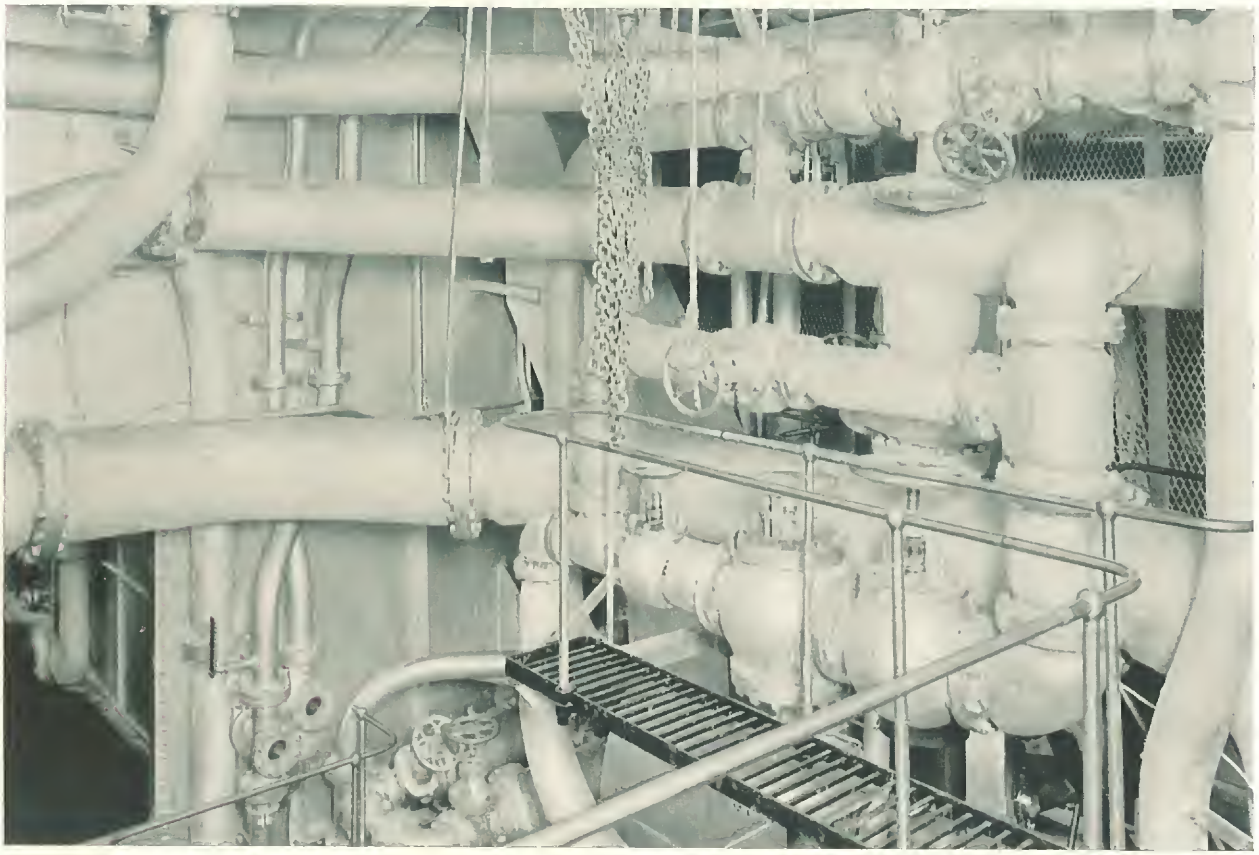
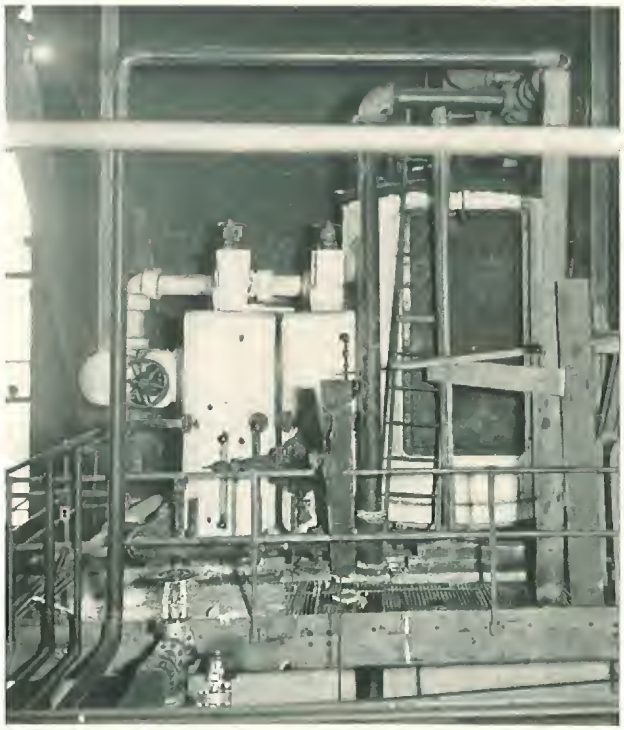


Fig. 46

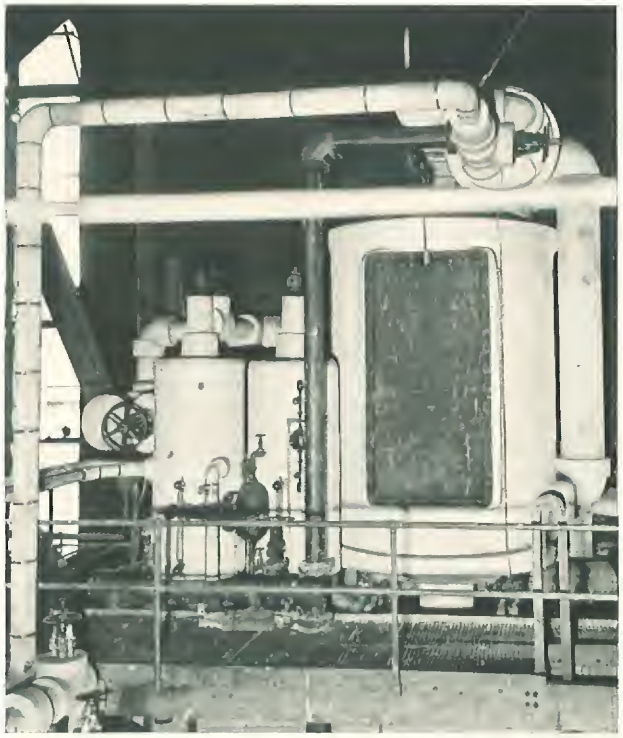
EHRET
INSULATIONS



Ehret's Enduro and 85% Magnesia maintain temperatures on steam lines carrying 750° superheat.



Heater tanks and piping on which Ehret's 85% Magnesia blocks are wired in place preparatory to finishing.



The same tanks shown at the left, after the asbestos finish has been applied over the wired-on blocks.

PIPE INSULATION

HOT PIPES—GENERAL

Materials

All pipes carrying steam, hot water, condensate or other heated fluids should be insulated with Ehret's 85% Magnesia Pipe Coverings or Ehret's combination Enduro-85% Magnesia Pipe Coverings, thicknesses to be in accordance with the following table:

MINIMUM THICKNESSES FOR
*INDOOR CONDITIONS

Temperature of Heated Surface, in Degrees, F.	PIPE SIZES							
	Under 2"		2" to 4"		4½" to 6"		7" and up	
	E	M	E	M	E	M	E	M
UP to 300	....	St.	....	St.	....	St.	....	St.
301 to 400	....	1½"	....	1½"	....	2"	....	2"
401 to 500	....	2"	....	2"	....	DS	....	DS
501 to 600	....	2"	....	2"	....	DS	....	DS
601 to 700	2"	.....	1½"	1½"	1½"	2"	1½"	2"
701 to 800	2"	.....	1½"	2"	1½"	2"	2"	2"
801 to 900	2"	.....	2"	2"	2"	2"	2"	2½"
901 to 1000	2½"	.....	2½"	2"	2½"	2"	2½"	2½"
1001 to 1100	2½"	.....	2½"	2½"	2½"	2½"	3"	2"

E—Enduro. M—85% Magnesia.
St.—Standard thick. DS—Double Standard thick.

* Where the insulation is to be applied on weather-exposed or extremely long lines, or where it is highly desirable to maintain temperatures or to minimize steam condensation, thicknesses should be at least ½" greater than those recommended in the above table.

Applications

PASTED AND BANDED COVERINGS

All single layer sectional coverings should be carefully fitted to the pipes with side and end joints butted tightly. The side and end laps of factory-weight canvas should then be pasted down smoothly. (Fig. 47.)

In applying double layer coverings the inner layer should be securely wired in place with No. 16 gauge annealed iron wire. The ends of all wire loops should be twisted together with pliers, bent over and carefully pressed into the surface of the covering. The outer layer should be applied with all side and end joints staggered. (Fig. 48.)

After the factory-weight canvas that is attached to the outer surface of sectional coverings has been smoothly pasted down, factory metal bands should be applied, two bands for each section of covering. One band should be placed at the mid-point of each section and one band centered over the joint at the end.

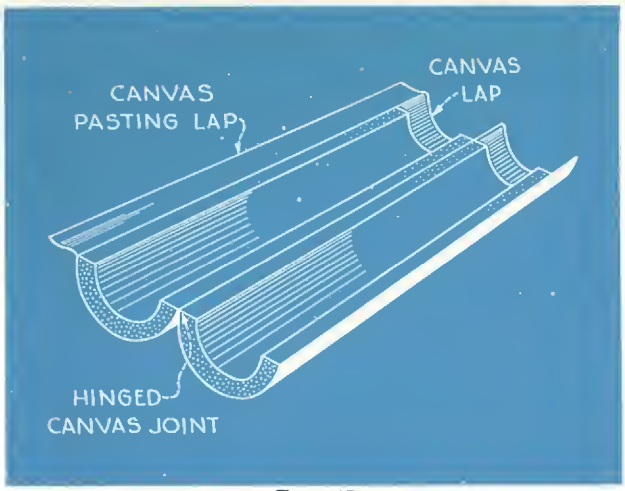


Fig. 47

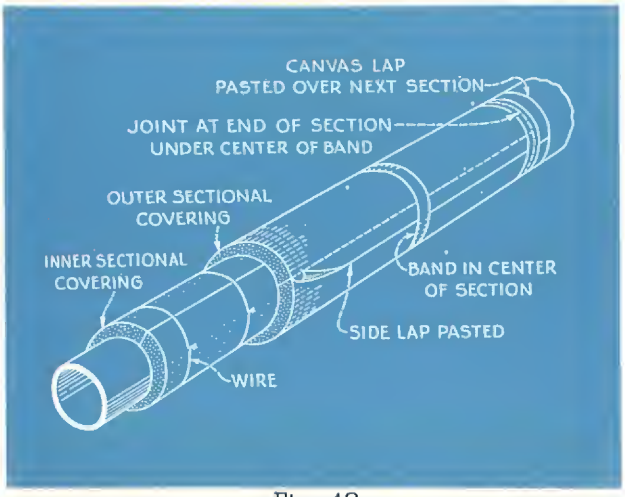
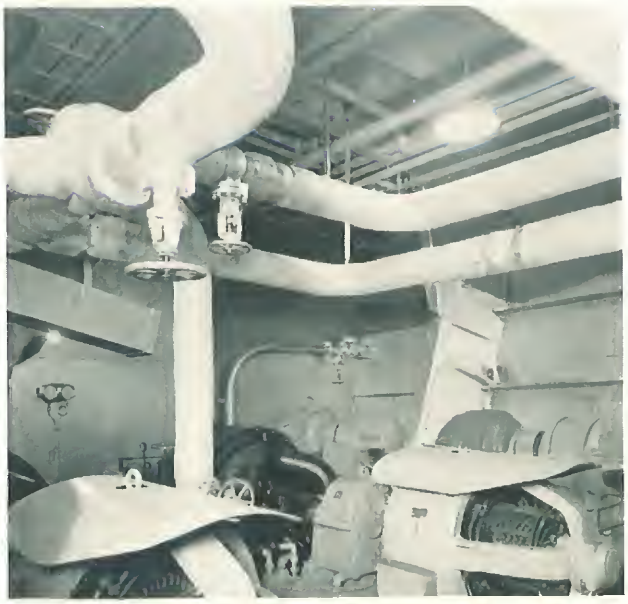


Fig. 48



Ehret insulations being applied to superheated steam lines on S. S. Standard Oil of California.

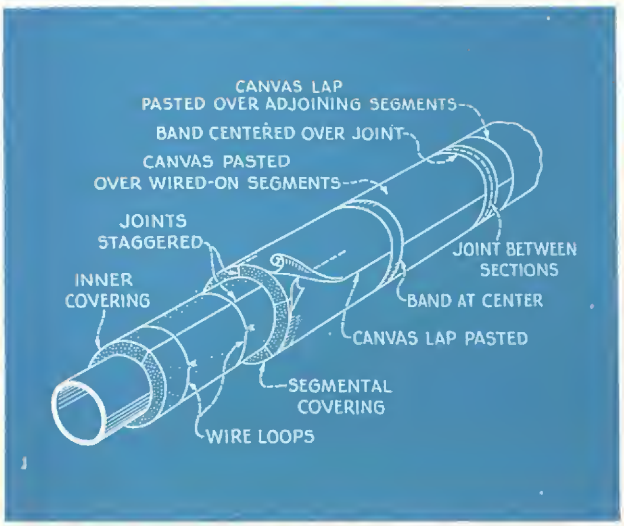


Fig. 49

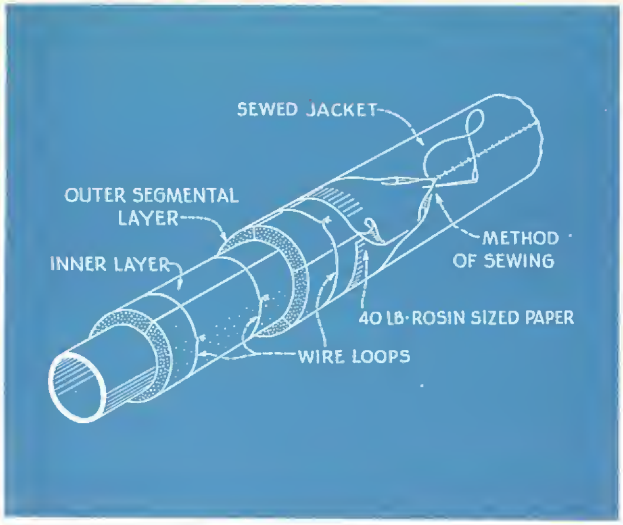


Fig. 50

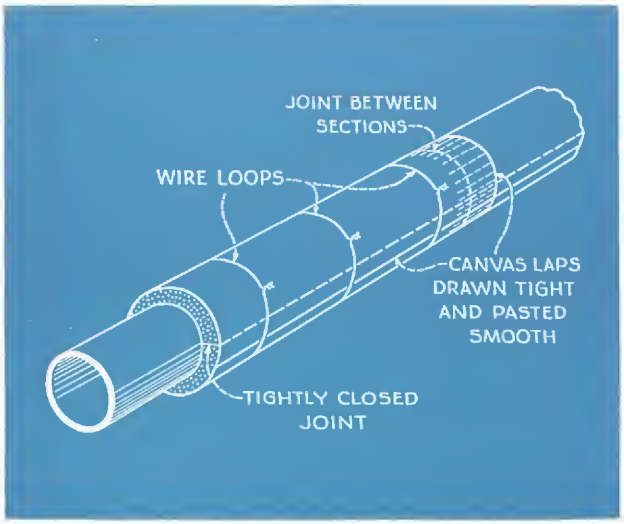


Fig. 51

All segmental coverings should be carefully fitted and applied in a manner similar to that specified for sectional coverings, except that since no factory-weight canvas is attached to the outer surface, both layers should be wired on in the manner described above for inner layers of double layer coverings. All joints should be staggered and tightly butted together and after being wired in place the joints between segments should be carefully tapped and rubbed closed with a smooth tool. Six ounce canvas should then be stretched over the surface of the wired-on segmental covering and pasted down smoothly with 3″ laps at all edges. Bands should then be applied in the manner described above. (Fig. 49.)

SEWED JACKETS

Where sewed jackets are desired, the coverings should be applied in the above described manner except the application of metal bands should be omitted and no canvas need be pasted over the wired-on segmental outer layers. On sectional coverings, at least three wire loops should be placed around each length of covering, over the pasted jacket. A jacket of 8 ounce enamelling duck should be then smoothly and tightly stretched around over a wrapping of 40 lb. rosin sized paper, this jacket to be securely and neatly sewed in place, with seams located where least visible. (Fig. 50.)

The general appearance of sewed jacket applications is improved when metal bands are placed on either side of fittings and at terminals such as walls, partitions or bulkheads.

CONCEALED PIPE COVERINGS

Where pipe coverings are to be concealed in walls, partitions, floors, etc., they should be applied in the same manner as described under Pasted and Banded Coverings except the metal bands are to be omitted, and instead, each section of covering should be securely fastened with three or more loops of No. 16 gauge soft copper wire. (Fig. 51.)

FITTINGS, VALVES AND FLANGES

All fittings, valves and flanges should be covered to the same total thickness as the insulation on adjacent piping.

On pipe sizes 4″ and larger, Ehret's Block insulation of the same material as that on the adjacent piping should be applied, allowing for a ½″

coating of finishing cement. These blocks should be carefully fitted and securely wired in place with No. 16 gauge annealed iron wire. Over the block surface Ehret's No. 150 Asbestos Cement should be applied in two layers to a total thickness of at least ½", with the surface trowelled to a smooth, hard finish. (Fig 52.)

For pipe sizes under 4" an all-cement insulation may be used. This should consist of Ehret's 85% Magnesia Cement for temperatures up to 600°F. and Ehret's No. 18 Heat-Seal Cement for higher temperatures. Application should be in two or more layers according to the required total thickness, and each layer of cement should be permitted to dry before the next is applied. If a final cement finish is desired, the last ½" layer should consist of Ehret's No. 150 Asbestos Cement trowelled smooth and hard. (Fig. 53.)

At flanges the pipe coverings should be terminated and bevelled off at sufficient distances to permit removal of the flange bolts. The insulation should consist of narrow blocks of the same material as that on the adjacent piping, allowing for a ½" cement finish and the insulation should extend about 2" over the ends of the adjacent pipe coverings. Where the diameter of the flange periphery is large enough, pieces of sectional or segmental pipe covering may well be used instead of narrow blocks. Number 16 gauge annealed iron wire should be used to secure the insulation, and over the wired-on blocks Ehret's No. 150 Asbestos Cement should be applied in two layers to a ½" thickness, with the surface trowelled to a smooth, hard finish. (Fig. 54.)

Where a canvas finish is desired on fittings, valves, or flanges, it may be applied directly over the cement surface, and it should conform to the finish on the adjacent pipe coverings. Where practicable, sewed jackets on adjacent pipe coverings should be continuous over the insulated valves or fittings.

REMOVABLE FLANGE INSULATION

Removable flange covers can be constructed by fastening the insulating blocks to the inside of sheet metal casings made in two or more sections. These sections should fit snugly around the flange and may be secured with wires, bands, or bolted lips.

NOTE: For weatherproofing, painting and underground insulation protection, see data sheet No. HCI 421.

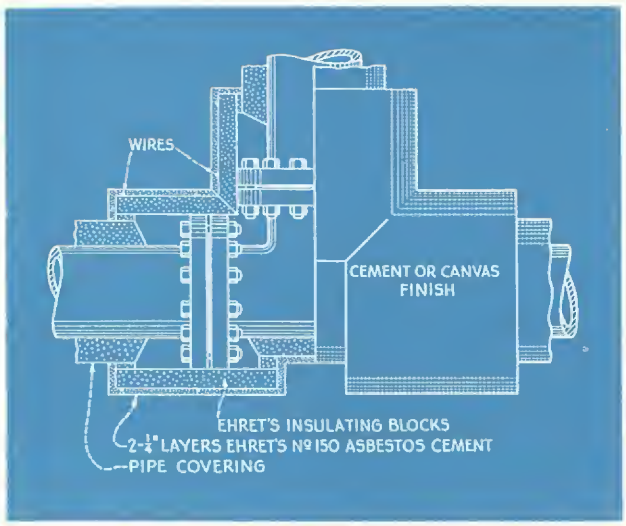


Fig. 52

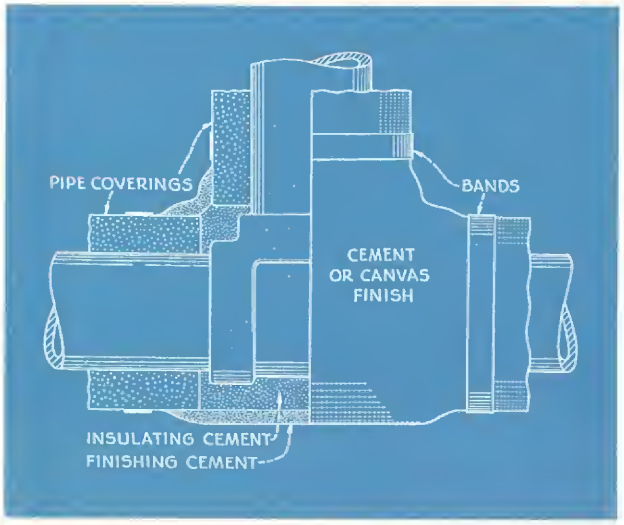


Fig. 53

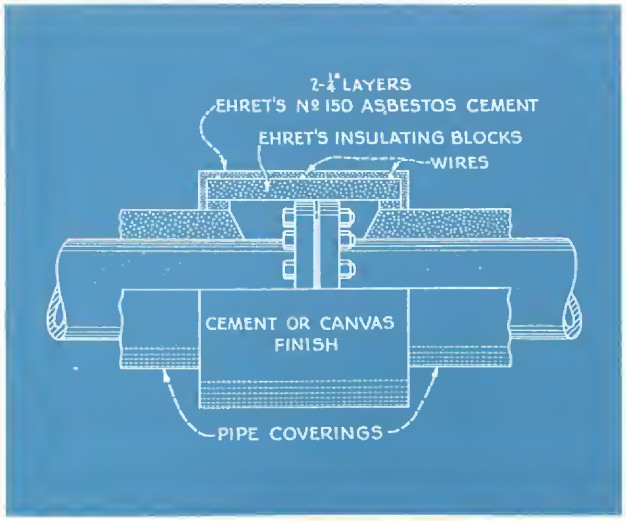


Fig. 54

PARALLEL PIPING

A small steam line is often run underneath another larger pipe carrying fluids which might freeze or congeal with cold. Insulation construction should encompass both pipes so as to permit the heat to be transferred from the steam line to the fluid line. Insulation methods for two types of service are here described.

High Temperature

When the steam is to be maintained at five pounds or more pressure, an all-85% Magnesia insulation should be applied. For indoor conditions the 85% Magnesia should be 1½" thick, and for outdoor lines a 2" thickness is recommended. Insulation is applied over a single layer of ½" square mesh hardware screening wrapped completely around the two pipes. Lap the longitudinal edges along one of the sides between the two pipes and securely fasten the screening with wire. (Fig. 55.)

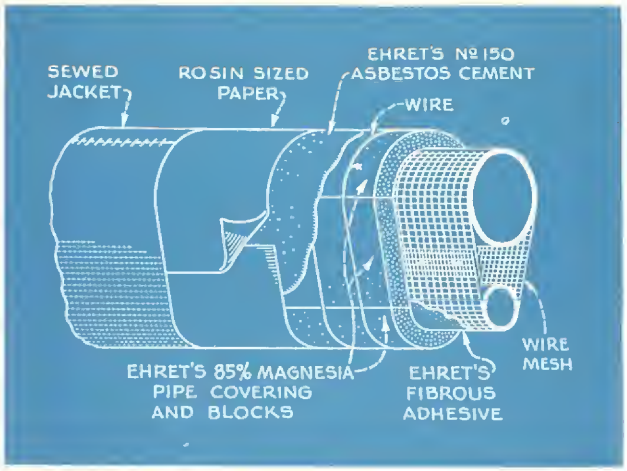


Fig. 55

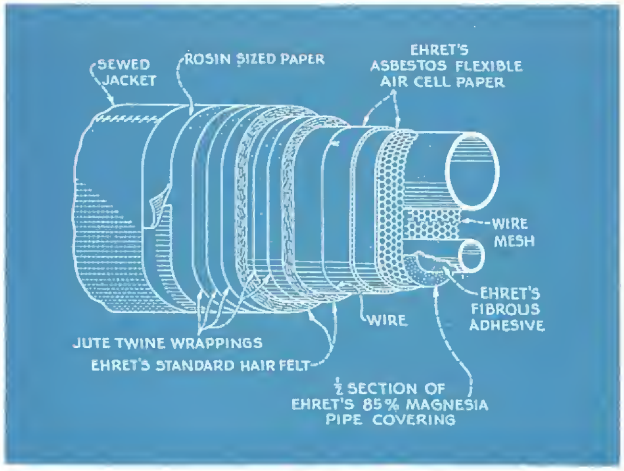


Fig. 56

Half sections of Ehret's 85% Magnesia Pipe Covering should then be fitted to the upper half of the large pipe and lower half of the small pipe, and the lower half section may be held in place with Ehret's Fibrous Adhesive. On the two sides, Ehret's 85% Magnesia Blocks of the proper thickness should be carefully fitted between the edges of the upper and lower pipe coverings. The two half sections and the side blocks should then be firmly wrapped with separate loops of No. 16 gauge annealed iron wire at 4" spacings. The ends of the loops should be twisted tight with pliers, bent over and gently pressed into the surface of the insulation. All joints should be thoroughly pointed up with Ehret's No. 150 Asbestos Cement, and the entire outer surface covered with a layer of this cement trowelled to a smooth, hard finish.

If the line is indoors, a sewed jacket of 8 ounce enamelling duck may be applied over a layer of 40 lb. rosin sized paper. The jacket should be smoothly and tightly stretched then securely and neatly sewed, with seams located where least visible.

If the line is outdoors, the sewed jacket should be omitted and a suitable weatherproofing applied.

Low Temperature

Where the steam pressure is to be less than five pounds, the following method of insulation may be used with satisfactory results.

Apply a half-section of Ehret's 85% Magnesia Pipe Covering to the lower half of the steam pipe, using Ehret's Fibrous Adhesive to hold it in place. Then wrap a single layer of 1" hexagonal mesh netting around both pipes, bringing it over the large bare pipe and under the lower outside surface of the half-section on the under half of the steam pipe. Lap and securely fasten the wire mesh along one of the sides between the pipes. Over the wire mesh wrap two layers of Ehret's Corrugated Asbestos Paper ¼" thick and secure these layers in place with separate loops of No. 16 gauge annealed iron wire at 10" spacings. (Fig. 56.)

Two separate layers of Ehret's Standard Hair Felt 1" thick should then be applied, each layer being firmly held in place by close wrappings of strong jute twine.

For indoor lines the covering may well be finished with an 8 ounce enamelling duck sewed jacket, and if outdoors, weatherproofing should be applied.

UNHEATED AND REFRIGERATED PIPING

COLD WATER

All cold water piping should be insulated to prevent the condensation of moisture which might drip and cause damage to materials or equipment placed underneath or to the building construction and finish.

Materials

Recommendations for both materials and thicknesses are as follows:

Humidity	INSULATION THICKNESS for Temperature Differences—		
	50 deg. F.	60 deg. F.	70 deg. F.
up to 70%.....	1"	1"	1½"
70% to 80%.....	1½"	2"	2"
80% to 85%.....	2"	2½"	3"

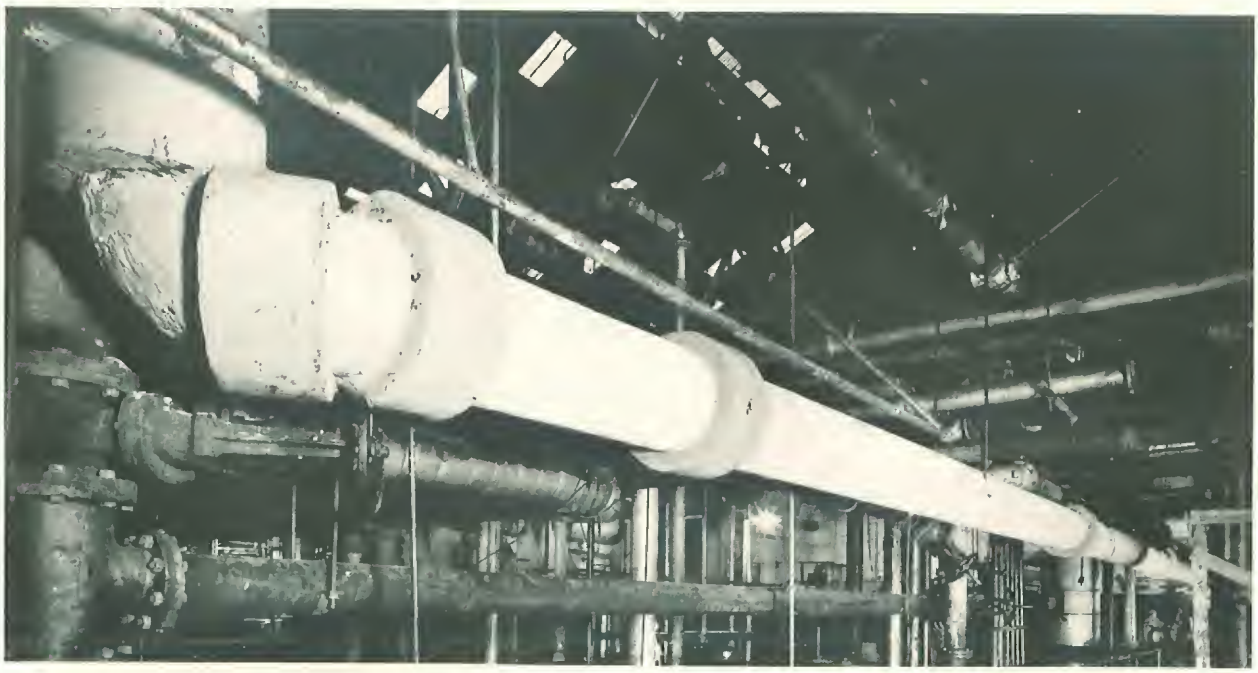
For the 1" and the 1½" thicknesses the first recommendation is to use Ehret's Anti-Sweat Covering. For greater thicknesses and as an alternate on the 1" and 1½" thicknesses, Ehret's Wool Felt Covering should be used, preferably in double-layer staggered joint construction in order to better insure against air leakage.

Application

In every case the metal surfaces are to be made absolutely clean and dry and the coverings are to be tightly fitted to the pipe with the jacket securely sealed with Ehret's Waterproof Cement along all longitudinal and circumferential joints. Two bands are to be applied for each 3 foot section, one band to be placed over the middle of the section, and the other band centered over the end joint.

If a sewed jacket is desired, the bands should be omitted and three separate loops of No. 16 gauge Copperweld wire wrapped around the outside surface of each section. The ends of the loops are to be firmly twisted with pliers, bent over and gently pressed down flush with the surface. The jacket of 8 ounce enamelling duck should then be tightly stretched over a wrapping of 40 lb. rosin sized paper, and all seams neatly and securely sewed, locating them where least visible. (Figs. 57 and 58.)

All flanges, valves and fittings should be insulated with Ehret's Standard Hair Felt to the same total thickness as the adjacent coverings. The hair felt is to be accurately fitted so that no cracks remain, and each layer should be securely held in place with close wrappings of strong jute twine. A layer of Ehret's Fibrekote ¼" thick should be



A large cold water line covered with two 1" layers of Ehret's Wool Felt and a trowelled-on coat of asbestos cement. A sewed jacket will be applied as final protection and finish.

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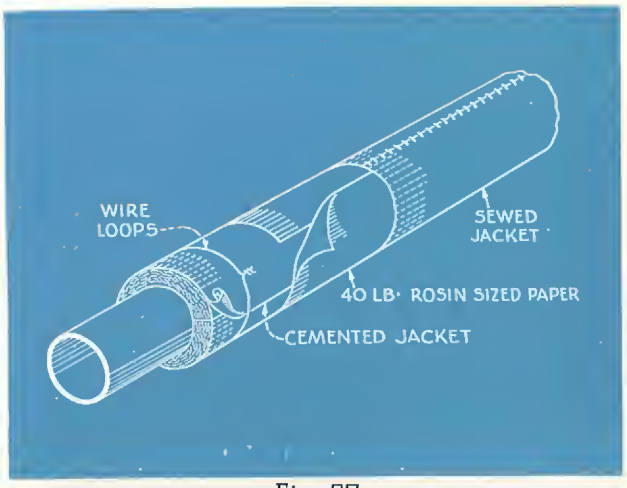


Fig. 57

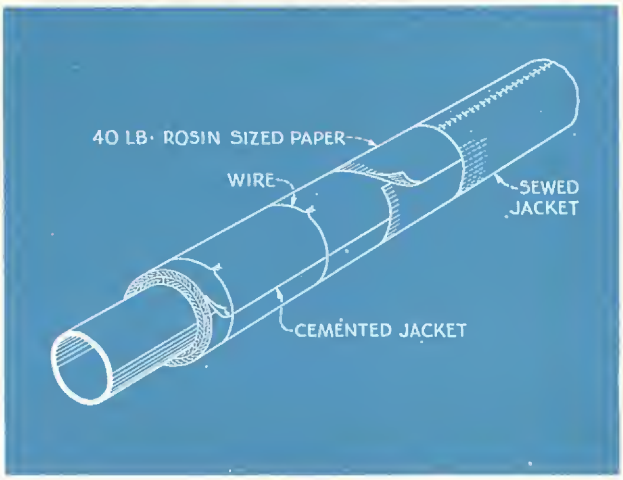


Fig. 58

firmly worked into the outer surface and trowelled smooth, using care to thoroughly seal the joints at the ends of the adjacent pipe coverings. The outer surface is then to be finished with a jacket of the same type, cemented or sewed, as that on the adjacent pipe covering.

Where an especially fine appearance is desired on exposed piping, the covering can be supplied with factory-attached Ehret's Alumino Jackets. Full description of this type of jacket will be supplied on request.

ICE WATER

If ice water piping is not thoroughly insulated a considerable amount of the power required to produce low temperatures will be wasted. In addition, much water will be unnecessarily drawn off and wasted in order to obtain cold water at drinking outlets. The following two insulating materials are satisfactory for this service.

Hair Felt Insulation

This type of insulation, 1″ thick, is our first recommendation. All metal surfaces should be made perfectly clean and dry, and the hair felt accurately cut so that it will fit snugly around the pipe with the longitudinal edges meeting closely without buckling. Care must be taken to prevent cracks at longitudinal or circumferential joints, because moisture condensed from entering air would seriously reduce, if not completely destroy, the insulating value of the covering. The hair felt should be held firmly in place with strong jute twine wound on at no greater than 1″ spacings.

For small pipes, Ehret's Frostproof Pipe Covering, which is made in pre-formed sections, may well be used. Not only is its insulation value adequate, but the application on small pipes is considerably simplified.

The finish may consist of an 8 ounce jacket tightly stretched on over a layer of 40 lb. rosin sized paper, and neatly and securely sewed. If the jacket is to be painted, 8 ounce enamelling duck should be used, and the seams should be located where least visible. (Fig. 59.)

Flanges, valves and fittings should be insulated with Ehret's Standard Hair Felt, to the same total thickness as the adjacent coverings. The hair felt is to be accurately fitted so that no cracks remain, and it should be secured with close wrappings of strong jute twine. A layer of Ehret's Fibrekote ¼″ thick should be firmly worked into the outer surface and trowelled smooth, using care to thoroughly seal the joints at the ends of the adjacent pipe coverings. The outer surface is then to be finished with a jacket of the same type as that on adjacent coverings.

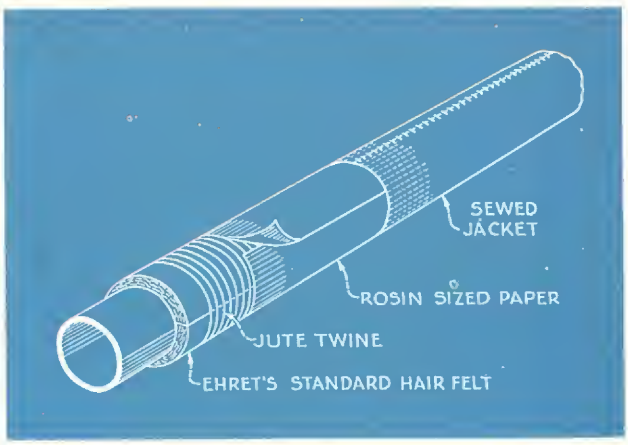


Fig. 59

Cork Insulation

When cork insulation is used on ice water piping it should also be used on all flanges, valves and fittings. Cork coverings for use on this service are known as "ice water thickness", and actual thicknesses vary from 1½" to 2", depending upon the size of the pipes.

When applying, care must be taken that all metal surfaces are perfectly clean and dry. After it is ascertained that the cork shapes will fit accurately and closely on the metal surfaces, they should be carefully applied with all joints set up with a waterproof cement, making sure that there are no cracks left which will permit air to enter. The pipe covering sections should be so placed that the longitudinal joints are along the top and bottom of the pipes. All pipe coverings are to be held in place with Copperweld wire having not less than six separate wire loops to each three foot section. These wires should be circumferentially straight around the coverings, and are to be drawn tight by twisting the ends with pliers, the twisted wire ends to be bent down and gently pressed into the surface.

Molded cork coverings for fittings may be cross-wired diagonally so that the wires will not slip off. All recesses in the coverings on fittings are to be filled with a mixture of melted paraffine and ground cork poured in through a drilled hole. The outer surfaces of all cork coverings are to be given a good coating of cork covering paint.

FROST AND NOISE PROTECTION

It is often necessary to protect cold water, fire, soil and waste lines from freezing, and it is also frequently desirable to reduce the noise of running water in certain soil and waste lines. For such services the following methods are recommended.

Materials and Application

For these purposes, Ehret's Standard Hair Felt in built up construction of three 1" layers should be applied in the following manner:

Before applying the insulation, the surfaces of the pipe should be made perfectly clean and dry. A layer of heavy tar paper should be wrapped around the pipe surface and over this the three layers of hair felt should be applied with a wrapping of heavy tar paper between each layer. (Fig. 60.)

Each layer of hair felt should be carefully cut and fitted so that the longitudinal joints fit snugly together with no overlapping or buckling. The tar paper should have a three inch lap at all edges and each layer should be carefully wrapped with strong jute twine at 1" spacings. An outside layer of tar paper should then be wrapped over the last layer of hair felt and fastened down with separate loops of No. 16 gauge Copperweld wire at 4" spacings. The ends of the wire loops should be twisted

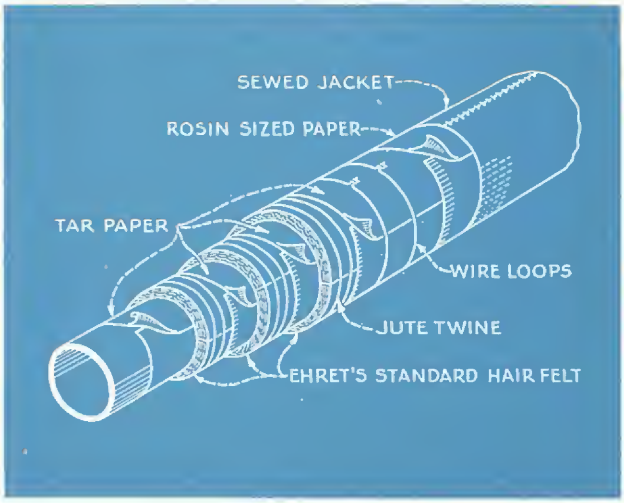
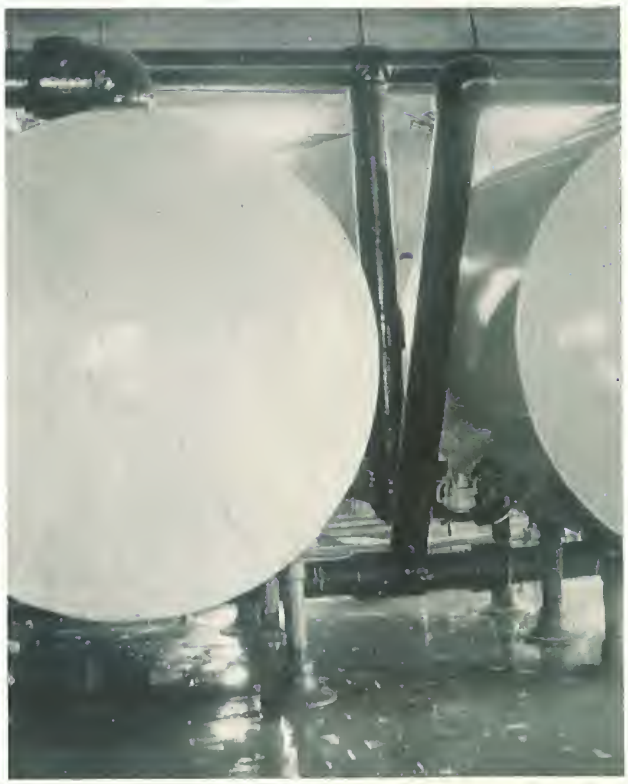


Fig. 60



Cork insulated cold water lines and storage tanks. Sheet metal jackets protect the tank insulation.

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together tightly with pliers, bent over and carefully pressed against the surface to avoid projections.

Where a sewed jacket is desired, a wrapping of 40 lb. rosin sized paper and a jacket of 8 ounce enamelling duck should be applied, the jacket to be smoothly stretched and neatly and securely sewed with seams located where least visible.

On small size pipes, where cold conditions are not likely to be severe, Ehret's Frostproof Pipe Covering 1¼" thick will provide adequate protection.

COLD WATER EQUIPMENT

Cold water equipment such as tanks, filters and traps, should be insulated in accordance with the following recommendations.

Materials and Application

For indoor locations the insulation should consist of Ehret's Standard Hair Felt, applied in two layers of 1" each. The surfaces to be insulated should be made clean and absolutely dry, and the first layer of hair felt neatly fitted so that all edges butt together snugly without overlapping or buckling. This layer should be firmly held in place with heavy jute twine wrapped around at 3" spacings. Tar paper should then be wrapped over the first layer and the second layer should be similarly fitted with all joints staggered and fastened on with separate wrappings of No. 16 gauge Copperweld wire at 3" spacings.

For indoor conditions, a jacket of 8 ounce enamelling duck may be tightly and smoothly applied over a wrapping of 40 lb. rosin sized paper, the jacket to be neatly and securely sewed with seams located where least visible. (Fig. 61.)

For weather-exposed conditions, the insulation should consist of three layers to a total thickness of 3". The sewed jacket should be omitted and the insulation weatherproofed.

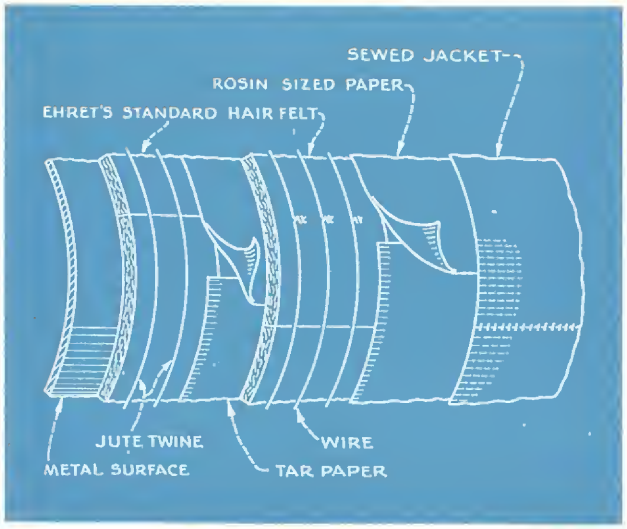

Fig. 61

Cold water storage tank supply line, showing Ehret's Hair Felt being applied between paper wrappings.

AIR CONDITIONING AND HEATING

WARMED AIR EQUIPMENT

Surfaces of all equipment for heating and circulating warmed air, such as air heaters, heater casings, blower housings and connections, warm air ducts, etc., should be insulated to prevent unnecessary temperature losses with consequent waste of fuel. Proper insulation also permits better operating control of the system resulting in uniform comfort for the occupants of the building.

Materials and Application

For ordinary conditions the insulation should consist of Ehret's 85% Magnesia Block 1½" thick. The blocks should be carefully fitted to the surfaces and held in place by means of a coating of Ehret's Fibrous Adhesive. Then ⅛" wire cables should be wrapped around or strung from anchors, with No. 16 gauge annealed iron wire lacings between the cables. (Fig. 62.) On the bottoms of ducts, supports such as screws, bolts, etc., should be provided to prevent the insulation from sagging.

Two inch hexagonal mesh netting should be neatly and smoothly fitted over the blocks and firmly wired down. Over this surface apply two coats of Ehret's No. 150 Asbestos Cement totalling at least ½" in thickness. The first coat is to be trowelled on firmly and permitted to dry before the second coat is applied. The second coat should be mixed with ⅓ by weight of portland cement if extra hardness is required.

If a sewed jacket is desired, 8 ounce enamelling duck should be smoothly and tightly stretched on over the cement finish with all seams neatly and securely sewed, and located where least visible.

COOLED AIR SYSTEMS

As the cost of artificially cooling air is much higher than the cost of heating it, there is even more reason for the application of adequate, dependable insulation on all parts of the cooling and circulating system, including pipes, equipment and ducts.

REFRIGERATING PIPING

Refrigerating piping, valves, flanges and fittings, should all be properly insulated in accordance with the recommendations for Refrigeration Piping.

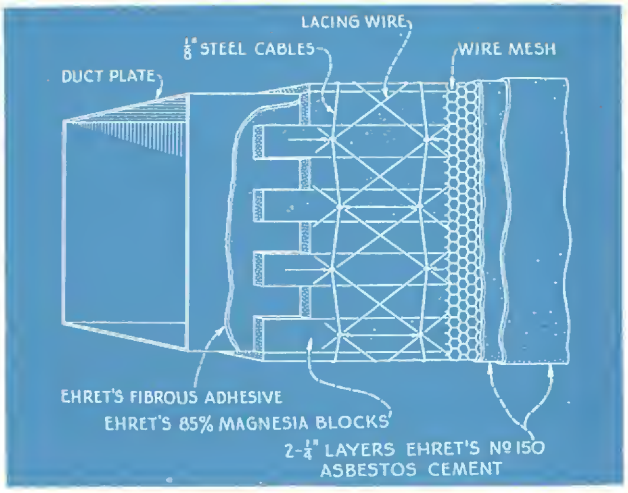

Fig. 62

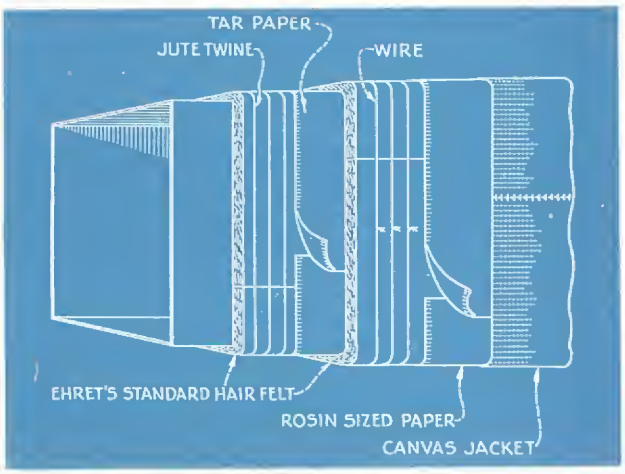

Fig. 63

EQUIPMENT AND DUCTS

Materials and Application

HAIR FELT INSULATION

Equipment should be protected with two 1" thick layers and ducts with one 1" thick layer. When applying, the metal surfaces should be made clean and perfectly dry, all joints in the insulation should be staggered and all edges should be neatly fitted and snugly butted so that no cracks remain and there should be no buckling or overlapping. The first layer of hair felt is to be firmly held in place with wrappings of strong jute twine at 3" spacings. The second layer should be applied over a wrapping of tar paper and then secured with separate wrappings of No. 16 gauge Copperweld wire at 3" spacings. (Fig. 63.)

The outer finish should consist of an 8 ounce enamelling duck jacket drawn on smooth and

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tight over a layer of 40 lb. rosin sized paper, with all seams neatly and securely sewed and located where least visible.

CORK INSULATION

Equipment should be protected with two 1″ thick layers and ducts with one 1″ thick layer. When applying, the metal surfaces should be made clean and perfectly dry and all joints in the cork should be neatly and closely fitted so that no cracks remain. The cork board is to be attached to the metal surfaces with a strong adhesive cement and then firmly held in place with loops of No. 16 gauge Copperweld wire at approximately 1 foot spacings with frequent lacings between as needed. All joints should be thoroughly sealed with a heavy waterproof cement. For concealed ducts no surface finish is required. (Fig. 64.)
Exposed ducts should have the corners of the cork insulation protected with light galvanized bent sheet iron angles and the entire surface finished with an 8 ounce jacket drawn on smooth and tight with all seams neatly and securely sewed and located where least visible.

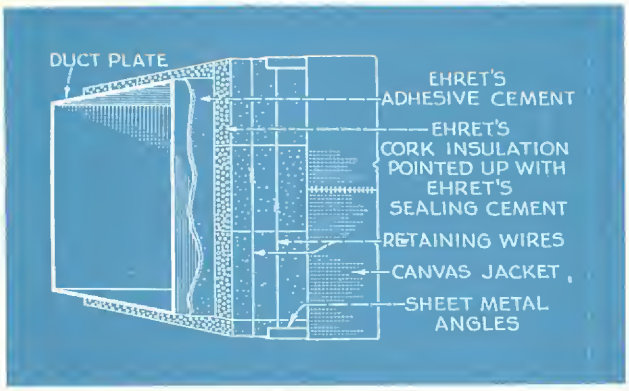


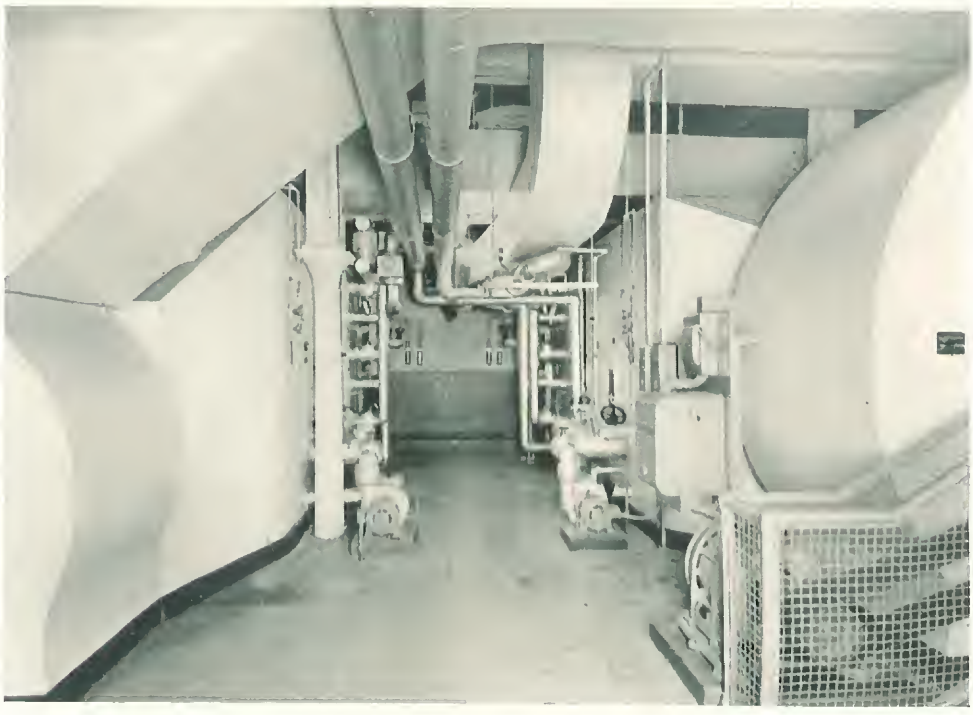
Fig. 64

VENTILATION

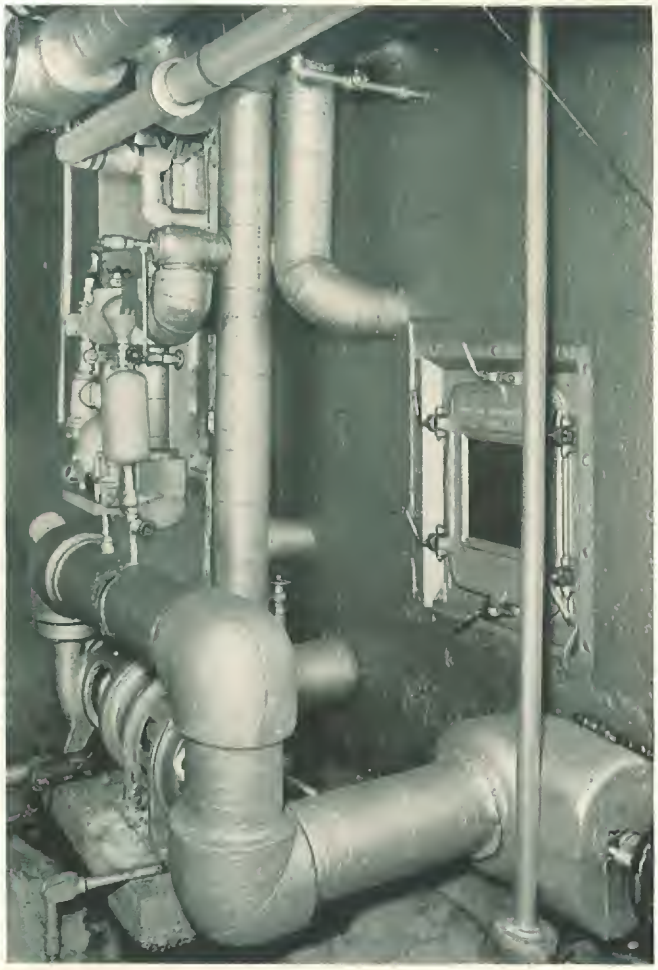
Materials and Application

All metal surfaces of such equipment as kitchen range hoods, exhausters and exhauster ducts should be insulated with Ehret's 85% Magnesia Block 1½″ thick. The blocks should be carefully fitted to the metal surfaces, using Ehret's Fibrous Adhesive wherever needed to facilitate the application. Then ⅛″ wire cables should be stretched around and between anchors provided by the sheet metal contractor, with No. 16 gauge annealed iron wire lacings between cables.

Over the wired-on blocks, 1″ hexagonal mesh netting should be tightly and smoothly stretched and fastened down. A finish should then be applied, consisting of two coats of Ehret's No. 150 Asbestos Cement totalling at least ½″ in thickness with the outer surface trowelled to a hard, smooth finish. The last coat should be mixed with ⅓ by weight of portland cement if extra hardness is desired.



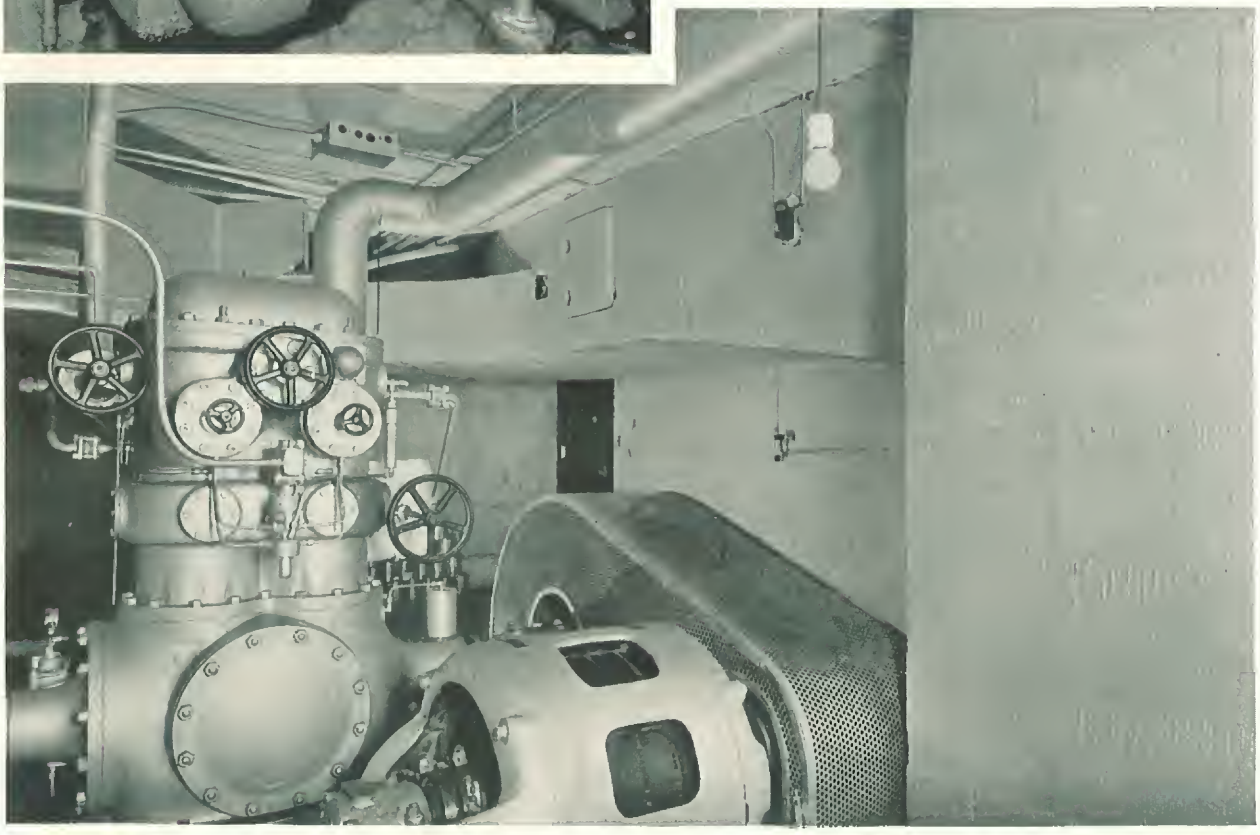
Fan Room in the U. S. Capitol Building, Washington, D. C. Pipes, ducts and blower housings are all covered with Ehret's Cork.



MODERN AIR CONDITIONING

. . . requires ample insulation of piping and equipment to hold operating costs at a minimum.

Ehret's Cork Pipe Coverings and Blocks were used on compressor lines, blower housings, ducts, circulating pumps and other cold and refrigerated equipment as here shown. This modern air-conditioning installation is in a store of the F. W. Woolworth Co. in Trenton, N. J.



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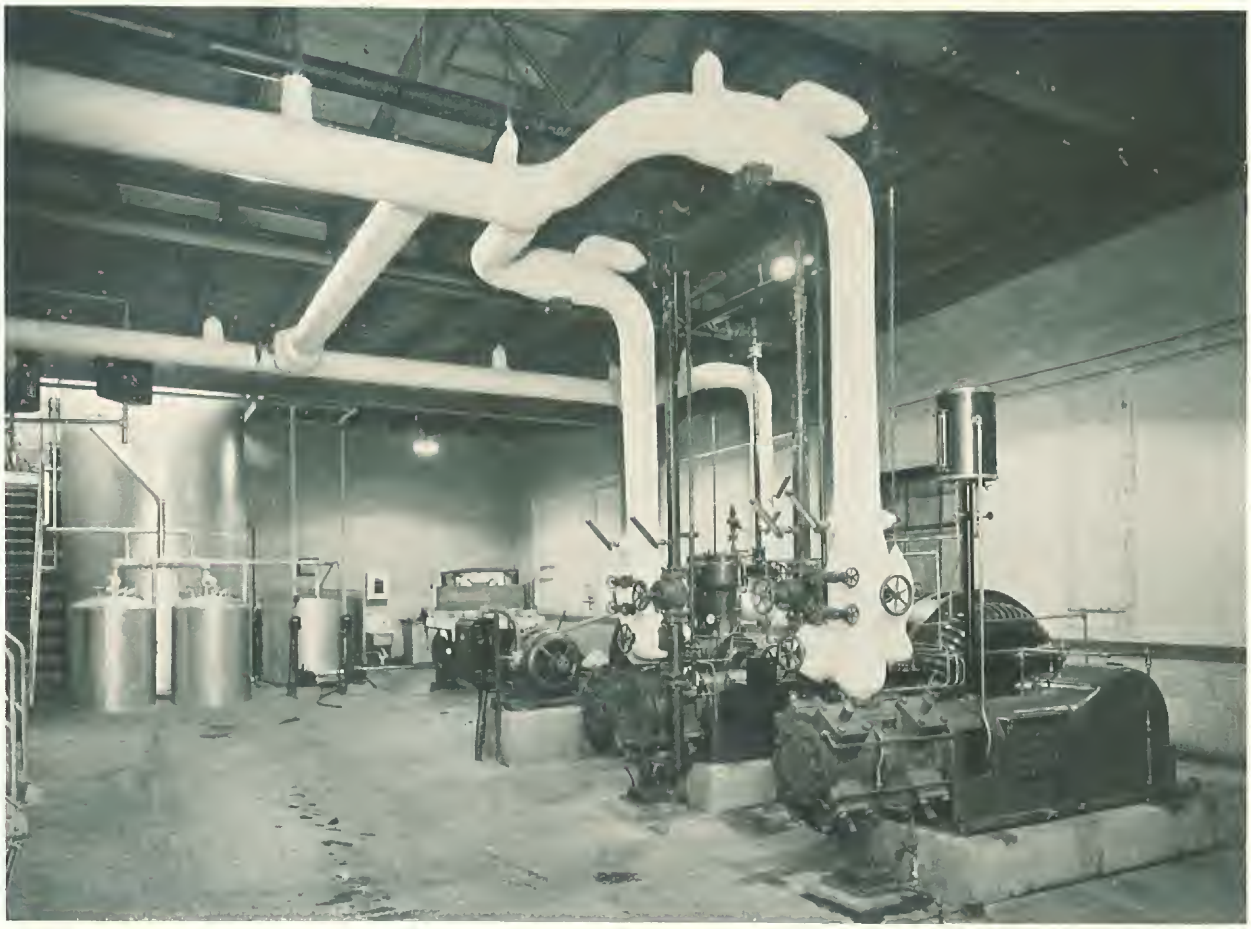
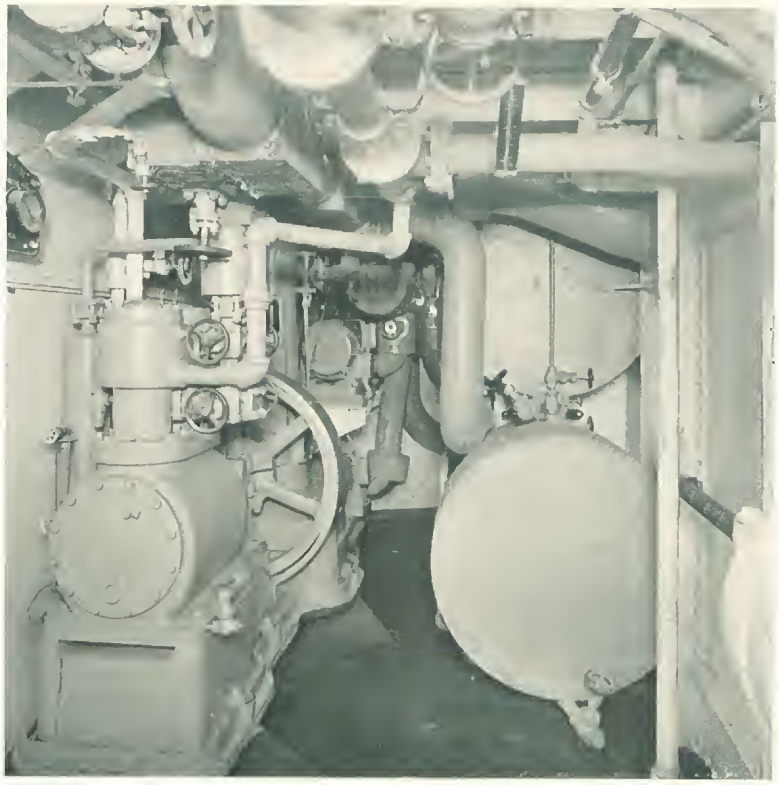
EHRET
INSULATIONS



REFRIGERATION

Shown above is a compressor room in the National Ice and Coal Co., Milwaukee, Wisconsin. Brine lines are insulated with Ehret's Hair Felt that is applied in layers to 3" of thickness. A white sewed jacket is used as a finish.

At the right is a view of refrigeration equipment on board the S. S. Seatrain New York. Ehret's Cork is used on tanks, piping and equipment. Cold air is blown into the 100 refrigerator freight cars that this deep-sea ship carries.



REFRIGERATION PIPING AND EQUIPMENT

Due to the high cost of producing subnormal temperatures, proper insulation of the entire cold generating and distribution system is of great importance. Not only must the insulation be highly efficient in preventing the entrance of heat, but it should also be proof against the infiltration of air. If air should enter through a crack or opening the contained moisture will condense in the interior of the insulation and, as there is no heat to drive it out, the moisture will accumulate until the covering is soaked and its insulating efficiency spoiled. If the temperature of the interior of the insulation is below 32° F. this condensed moisture will freeze and mechanically damage or ruin the insulation.

HAIR FELT INSULATION

For air-tight, highly efficient insulation, Ehret's Standard Hair Felt built up in successive 1″ layers is recommended. Thicknesses should be in accordance with the following table:

Temperature range in Degrees F.	Total Thickness of Insulation
15 to 50	2″ (2–1″ layers)
zero to 15	3″ (3–1″ layers)
–20 to zero	4″ (4–1″ layers)
–40 to –20	5″ (5–1″ layers)
–60 to –40	6″ (6–1″ layers)
–80 to –60	8″ (4–1″ and 2–2″ layers)
–100 to –80	10″ (4–1″ and 3–2″ layers)
–120 to –100	12″ (4–1″ and 4–2″ layers)

Application

Before the insulation is applied all pipe surfaces should be made perfectly clean and dry. A layer of tar paper should be wrapped over the pipe surface and separate layers of hair felt alternated with single layers of tar paper should be applied until the desired thickness is obtained. The hair felt is to be accurately cut and fitted so that all joints are snug and tight with no cracks, overlapping or buckling. Layers should be applied with staggered joints and each layer securely held in place with wrappings of heavy jute twine at 1″ spacings. (Fig. 65)

After the insulation has been applied to the desired thickness, the outer surface should be wrapped with a layer of tar paper and secured with No. 16 gauge Copperweld wire loops at 4″ spacings. The ends of the wire loops should be firmly twisted together with pliers, bent over and carefully pressed against the surface to avoid projections. All tar paper layers are to have 3″ laps at all edges.

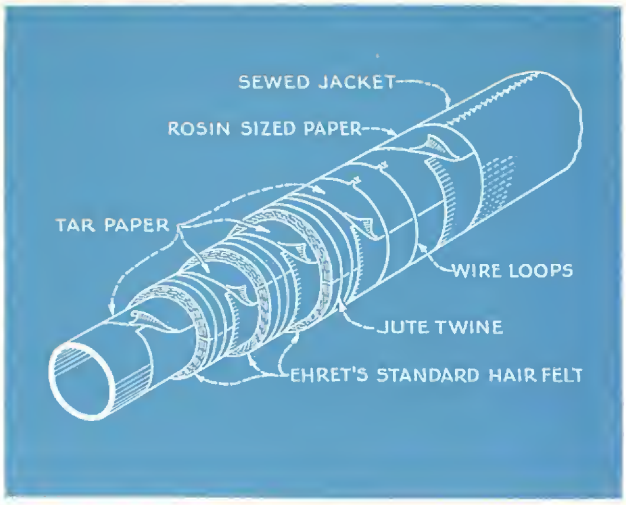
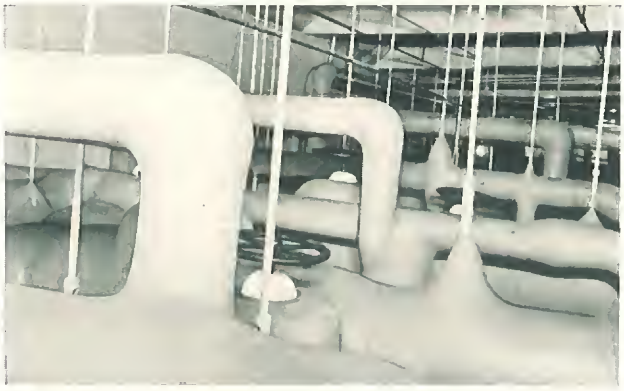


Fig. 65

It is sometimes desirable for purposes of excluding moisture, that each layer be completely air-sealed. In such cases, the tar paper between layers should



These two pictures show insulated brine lines and tanks in the Central Cold Storage plant in Chicago. Three 1″ layers of Ehret's Hair Felt sealed with hot asphalt were used, and 8 ounce canvas jackets provide the neat, finished appearance.

be omitted and either a coating of a waterproof sealing compound, or a spiral wrapping of a heavy self-sealing tape should be applied to each layer.

If a sewed jacket finish is desired, 8 ounce enamelling duck should be drawn tightly and smoothly over a wrapping of 40 lb. rosin sized paper, and then neatly and securely sewed with seams located where least visible.

The insulation on flanges, valves and fittings should be of the same material and thickness as that on the adjacent piping. The pipe insulation adjacent to flanges should be stopped off at a sufficient distance to permit the removal of flange bolts. The ends of the pipe insulation should be tapered and tightly bound with close wrappings of twine, and then thoroughly coated and sealed to the pipe with a waterproof sealing compound.

When covering the flanges, all layers should be firmly held in place by close wrappings of strong jute twine applied in a criss-cross manner. The inner layers of the hair felt should be tucked down closely over the sides of the flange. The top layer of hair felt should be cut long enough to permit overlapping the adjacent pipe covering for a distance of 3″ beyond the taper, and it should be wrapped smoothly and sealed down onto the pipe covering with a heavy coat of a waterproof sealing compound.

The outside finish should be the same as that on the adjacent pipe coverings. Where there are sewed jackets on the pipe coverings, these jackets may be extended to include valves and fittings.

CORK INSULATION

Ehret's Cork Insulation may be used for refrigeration piping and equipment. Recommended thicknesses for this material are as follows:

Temperature Degrees F.	Designated Service	Thickness in Inches
Above 25.....	Ice Water.....	1½ to 2
Zero to 25.....	Brine.....	2 to 3
Below zero.....	Heavy Brine.....	3 to 4

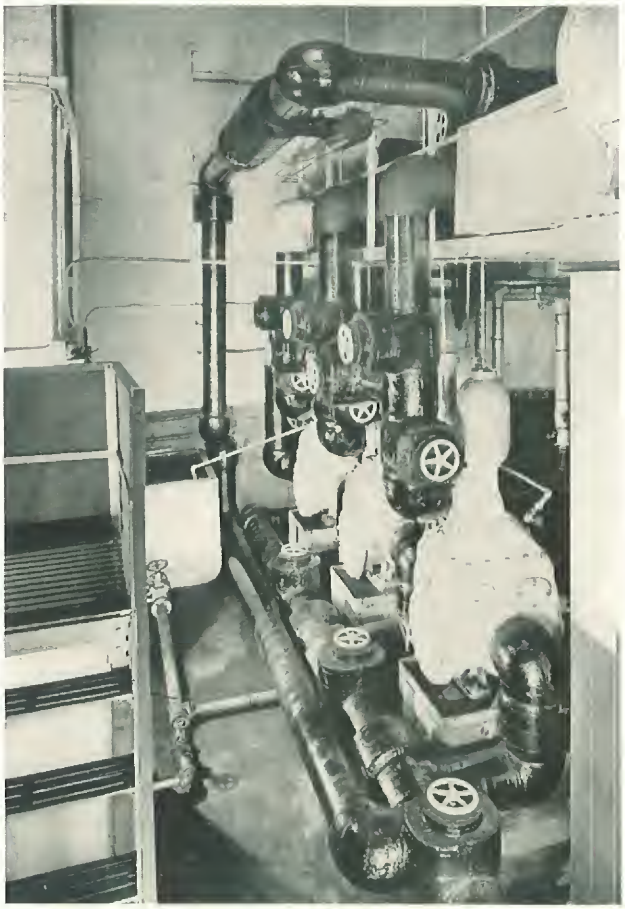
Application

In applying molded cork shapes to piping, flanges, valves and fittings, care should be taken that all metal surfaces are clean and perfectly dry. After it is ascertained that the cork shapes will fit accurately and closely on the metal surfaces, they should be firmly applied with the joints set up in a waterproof cement, making sure that there are no cracks left which will permit air to enter. The pipe covering sections should be so placed that the longitudinal joints are along the top and bottom of the pipes.

All pipe covering shapes are to be held in place by means of Copperweld wire having not less than six separate wire loops to each 3 foot section. These wires should be circumferentially straight around the covering and are to be drawn tight by twisting the ends with pliers. Wire ends should be bent over and pressed into the surface to avoid projections. Molded coverings for fittings should be cross-wired diagonally so that the wires will not slip off.

All recesses in the coverings on fittings are to be filled with a melted mixture of paraffine and ground cork, poured in through a drilled hole.

For indoor lines the entire outer surface of the cork insulation should be given a good coating of a cork covering paint.



Cork insulation on refrigeration piping in the Bush Terminal, Brooklyn, N. Y.

PROTECTING AND FINISHING

WEATHERPROOFING

Where insulation on hot and cold pipes and equipment is to be subjected to weathering, dampness, excessive humidity or conditions of occasional wetting, it should be protected with adequate and reliable weatherproofing. The following methods of weatherproofing will answer practically all needs.

DURANT SYSTEM

On new construction, the first recommendation for weatherproof pipe insulation is the Durant System, fully described on other Ehret data sheets.

MEMBRANE TYPES

Wrapped Jackets

Membrane type wrapped weatherproofing as here described for pipe insulation, is equally applicable to insulated breechings, ducts, tanks, and other such equipment on which weather protection is required.

The insulation on piping that is to be weatherproofed should be applied in the same manner as that described for Sewed Jackets, except that instead of applying the rosin sized paper and sewed jacket, a wrapping of Ehret's 50-pound asphalt saturated-and-coated Roofing Felt should be smoothly and tightly applied. At least 3" laps should be provided at all edges and joints should be sealed with a waterproofing compound. All horizontal joints in the felt membrane should be lapped *over* so as to shed water.

After the roofing felt has been applied and the laps sealed, separate loops of No. 16 gauge Copperweld or copper wire should be firmly fastened around the weatherproofing at equal spacings of not more than 6". The ends of the wire loops should be twisted tight with pliers and turned over to avoid projections, care being taken not to puncture the weatherproofing. (Fig. 66.)

All flanges, valves and fitting insulation should be given a trowelled-on coating of Ehret's Fibrekote weatherproofing plastic at least ¼" thick, with the surface neatly smoothed off. Care should be taken to lap and seal the plastic weatherproofing at least 2" over the membrane protection on the pipes.

If fire-resistant characteristics are desired in membrane type weatherproofing jackets, Ehret's Asbestkote should be applied in the manner described above for roofing felt.

Wrapped weatherproofing on steam lines above the roof of the Hammermill Paper Co. plant in Erie, Pa.

Factory-attached Jackets

Sectional pipe coverings are available with factory-attached weatherproofing jackets. These sections should be applied with the horizontal laps turned downward, and sealed with a waterproof sealing compound. All joints between sections should be carefully sealed with a 6"-wide strip of weatherproofing felt, centered and cemented over the joint and lapped at the side. The entire weatherproofing should then be securely wired, as described for Wrapped Jackets.

PLASTIC TYPE

A plastic type of weatherproofing is sometimes required, especially for protruding, uneven or odd

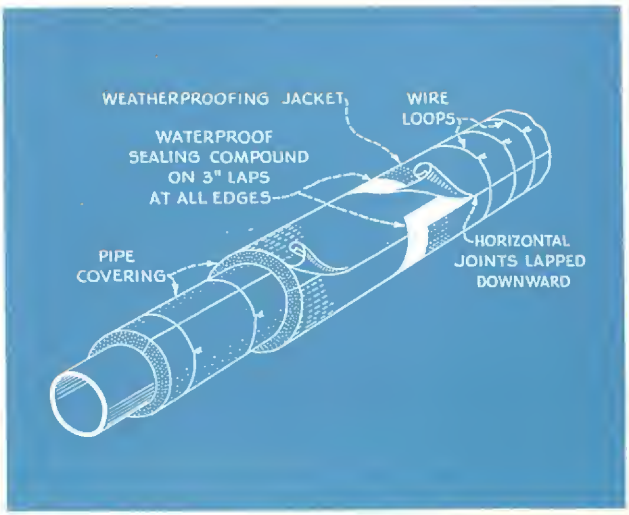


Fig. 66

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shaped surfaces. Ehret's Fibrekote is an ideal material for this purpose, and it should be trowelled on in successive layers to the desired thickness, allowing each layer to dry before the next is applied, and the last layer should be trowelled to a smooth water-tight finish. A final mopping of hot asphalt over the Fiberkote surface adds to the life of the weatherproofing.

PAINTING

When sewed jackets are to be painted, 8 ounce enamelling duck should be used as this material requires no priming. When 8 ounce canvas is used, it needs to be given a coat of glue sizing before the paint is applied. Two coats of a high grade lead and oil paint of the desired color should be applied to all surfaces.

Where a hard-finished cement surface is to be painted, 6 ounce canvas should be neatly pasted on before the 2 coats of paint are applied. This provides a satisfactory bond for the paint, which would be likely to flake or peel off if applied directly to the cement surface.

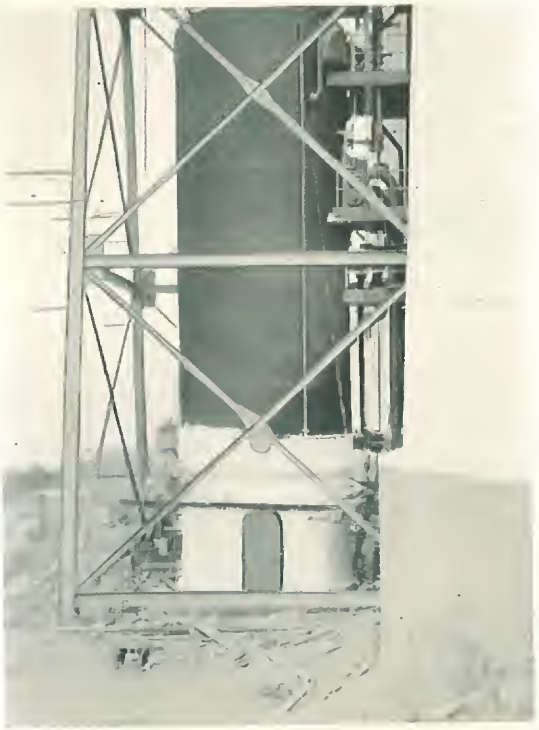
The outer surfaces of weatherproofing felt should be given one heavy coat of a good asphalt paint. This should be done after the felt is wired on.

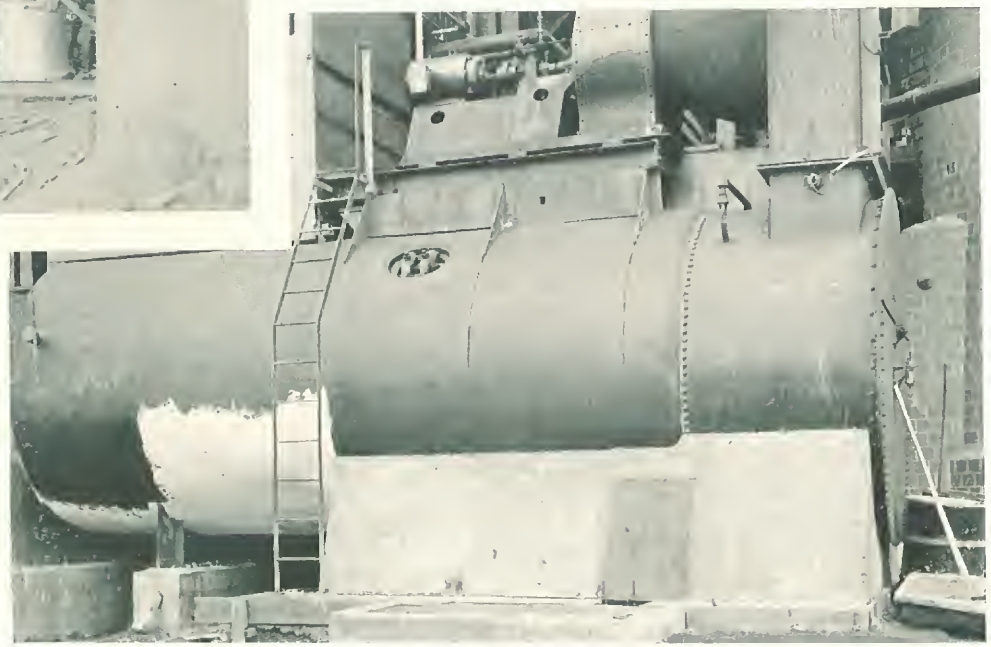
Cork pipe coverings and blocks should be given one coat of a good cork-covering paint after the insulation has been applied.

UNDERGROUND PIPING

One of the most important points to consider when deciding on a method of protecting the insulation on underground piping, is *dependability.* The entrance of moisture or water into the insulation will result in power losses, the total cost of which over a period of time is likely to amount to astonishing figures. And unfortunately, such losses usually take place without giving the least indication of their existence. The possibility of such costly losses should be guarded against.

Our recommendation for use on underground piping is the Durant System of Pre-sealed Insulated Pipe. Full details of the Durant System will be found on other Ehret data sheets.





Insulated sedimentation tank (above) and waste heat boiler (right) that are being weatherproofed with Ehret's Fibrekote, trowelled-on in 2 layers.

SHORT FORM SPECIFICATIONS

for Furnishing and Applying Ehret's Insulations

(I) GENERAL

(1) MATERIALS AND WORKMANSHIP

Insulating materials in this specification shall be furnished by the Ehret Magnesia Manufacturing Company and the application of these materials shall be made by this company or their approved contractors.

All work shall be done in accordance with the detailed specifications. Applications shall be made and finished in a neat and workmanlike manner.

(2) FINISHES

(A) Cement

Where specified, Cement Finish over insulation shall consist of two layers of Ehret's No. 150 Asbestos Cement totaling at least ½" in thickness. The outer surface of the last layer shall be trowelled to a smooth hard surface.

(B) Hard Cement

Where a Hard Cement Finish is specified it shall be applied in the same manner as described under Cement Finish except that the outer layer shall be mixed with ⅓ by weight of portland cement.

(C) Pasted Canvas

Where specified, canvas of the designated weight shall be neatly and smoothly pasted over the applied insulations.

(D) Sewed Canvas

Where specified, Sewed Canvas Jackets shall be applied over insulated surfaces in the following manner. The insulation shall be covered with a layer of 40-lb. rosin-sized paper and an 8-oz. enamelling duck (or other designated weight of canvas) shall be smoothly stretched and neatly and securely sewed over the paper. Seams shall be located where least visible.

(II) RESIDENTIAL HEATING

(3) HOT AIR SYSTEMS

(A) Furnace

The sides and top of the outer sheet metal casing shall be insulated with Ehret's 85% Magnesia Block 1" thick. The insulation shall be attached to the metal surfaces with Ehret's Fibrous Adhesive and further secured with 1" wire cables and No. 16 gauge annealed iron wire lacings. 2" hexagonal mesh netting shall then be tightly stretched over the blocks and a Cement (or Hard Cement) Finish shall then be applied. After the finish is dry, a 6-oz. canvas jacket shall be pasted on.

(B) Exposed Ducts

Round pipes shall be wrapped with two layers of Ehret's Corrugated Asbestos Paper, ¼" thick. The insulation shall be secured in place by separate groups of No. 16 gauge Copperweld wire on 6" spacings. Rectangular ducts shall be insulated with Ehret's Air Cell Board, 2 ply, ½" thick. The insulation shall be cemented to the metal surfaces with Ehret's Fibrous Adhesive and further secured with loops of No. 16 gauge Copperweld wire.

All joints shall be covered with Ehret's Asbestos Furnace Tape, securely cemented on. After the joints have been sealed, 6-oz. canvas jacket shall be pasted on.

(4) STEAM, VAPOR AND HOT WATER SYSTEMS

(A) Boilers (round or sectional)

Where the metal surfaces are not smooth, they shall be filled in and trowelled to a smooth surface with Ehret's 85% Magnesia Cement. The surfaces shall then be insulated with Ehret's 85% Magnesia Block, 1" thick. The block shall be attached with Ehret's Fibrous Adhesive and further secured with ⅛" wire cables and No. 16 gauge wire lacings. 2" hexagonal mesh wire netting shall then be tightly stretched over the blocks and secured in place. A Cement (or Hard Cement) Finish shall then be applied. After the Cement Finish is dry, a 6-oz. canvas jacket shall be pasted on.

(B) Piping

All supply and return pipes shall be insulated with Ehret's 85% Magnesia Sectional Pipe Covering, Standard thick. The flaps of the factory canvas jackets shall be neatly and securely pasted down. Metal bands shall then be applied, one around the center of each section and one centered over each joint.

(C) Fittings

All fittings shall be insulated with Ehret's 85% Magnesia Cement, applied in two layers to a total thickness equal to that of the adjacent pipe covering. After the cement is dry, 6-oz. canvas shall be smoothly pasted on.

(III) GENERAL HEATING AND POWER

(5) BOILERS AND BOILER SETTINGS

(For full details regarding materials, thicknesses and methods of application for the various types of boilers, see Ehret Data Sheets Nos. HCI 402, 404, 405, 406 and 408.

(6) BOILER TUBE DOORS

Recessed doors shall be insulated with a filling of Ehret's Durocel Insulating Concrete tamped in around anchor bolts.

Flat or shallow doors shall be insulated with Ehret's Asbestofibre Felted Sheets, 2" thick, with the exposed face protected with Ehret's Pyroboard ¼" thick. The insulating and protective lining shall be firmly fastened to the door by bolts through the entire assembly.

(7) SMOKE FLUES AND UPTAKES

(A) Internal Insulation

Ehret's Enduro Block, 2" thick, shall be applied to the steel surfaces with Ehret's Fibrous Adhesive. A layer of 1" hexagonal mesh netting shall then be stretched over the inner surface of the insulating blocks and drawn up tightly against the blocks by means of hair pin wires looped through anchors that were previously welded to the inner steel surfaces. These anchors shall have 12" x 12" spacings on the top surface and 24" x 24" spacings on the sides. (Anchors are not usually required on the bottom surface.) The inside exposed surface of the insulation is then to be given two coats of Ehret's No. 119 Semi-Refractory Cement totaling at least ¾" thick, and trowelled to a firm and smooth finish.

(B) External Insulation

V-rib metal lath or a similar approved metallic support shall be firmly attached over the entire outer surface. Ehret's 85% Magnesia Block 2" thick (for flue temperatures not exceeding 600 degrees F.) or Ehret's Enduro Block 2" thick (for higher flue temperatures) shall then be applied. The insulating blocks shall be securely retained by wire cables, lacings and 2" hexagonal mesh netting that is tightly

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stretched over the blocks and securely fastened. The outer surface shall then be covered with a Cement (or a Hard Cement) Finish.

(8) ECONOMIZER AND AIR PREHEATER DUCTS

An insulation lining consisting of Ehret's Enduro Block 2" thick, mesh wire reinforcement and a protection of Ehret's No. 119 Semi-Refractory Cement shall be provided. (The method of application to be similar to that specified for the internal insulation of flue linings.)

(9) STACKS

Steel stacks shall be lined with Ehret's Fyrbestos, 2" thick (or with Ehret's Vitrified Asbestofibre Felted Sheets 2" thick), of the proper curvature and supported by and fastened to $1\frac{1}{2}$" x $1\frac{1}{2}$" x $\frac{3}{16}$" angle iron rings welded to the inner surface of the stack by the stack manufacturer. All metal clips, projections and cracks shall be thoroughly covered with Ehret's No. 119 Semi-Refractory Cement. Protection shall be provided at the top edge of the stack to prevent water from entering the lining. Where unlined portions of a steel stack pass through portions of a building, the outer surfaces shall be insulated by a layer of Ehret's 85% Magnesia Block, 2" thick, applied over a V-rib metal lath. The blocks shall be securely fastened by $\frac{1}{8}$" wire cables and wire lacings and then finished with a Cement (or Hard Cement) Finish.

(10) CEILING INSULATION

The insulation shall consist of Ehret's 85% Magnesia Block from 2" to 3" thick (according to temperature conditions). The block shall be applied directly to the ceiling or attached to a suspended steel supporting system. (For full details see Ehret Data Sheet No. HCI 414.)

(11) AUXILIARY EQUIPMENT

Heated surfaces of all traps, receivers, tanks, heaters, engines, etc., shall be completely insulated in accordance with the recommendations as shown in *Table 1.*

Wherever practical, the blocks shall be first attached by means of Ehret's Fibrous Adhesive then further secured with $\frac{1}{8}$" wire cables and No. 16 gauge wire lacings. Hexagonal mesh netting shall then be stretched and secured over the surfaces and a Cement (or Hard Cement) Finish applied.

TABLE 1

Temperature of Hot Surface (in degrees F.)	Thickness	
	Enduro	85% Magnesia
Under 300	....	$1\frac{1}{2}$"
301 to 400	....	2"
401 to 500	....	$2\frac{1}{2}$"
501 to 600	....	3"
601 to 700	$1\frac{1}{2}$"	2"
701 to 800	2"	2"
801 to 900	2"	2"
901 to 1000	$2\frac{1}{2}$"	$2\frac{1}{2}$"

(12) HOT PUMPS

All steam and hot water cylinders and chests shall be insulated with Ehret's 85% Magnesia Block, 2" thick, securely fastened with No. 16 gauge Copperweld wire, pointed up and smoothed over with Ehret's 85% Magnesia Cement and protected with fitted sheet metal casings. The insulation on pump heads and chests shall be built into sheet metal forms that fit snug and tight, yet are readily removable.

(13) COLD WATER PUMPS

The insulation shall consist of Ehret's Standard Hair Felt of the same thickness as that of the insulation on the adjacent cold water piping. It shall be securely fastened on by wrappings of heavy jute twine and No. 16 gauge Copperweld wire. The outer surface of the insulation shall be protected with a coating of Ehret's Fibrekote, at least $\frac{1}{4}$" thick, trowelled smooth.

(14) FUEL OIL HEATER AND PIPING

The heater shall be insulated with Ehret's 85% Magnesia Block, 1" thick, applied as specified for Auxiliary Equipment. The oil lines that run from the heater to the burners shall be insulated with Ehret's 85% Magnesia Pipe Covering, Standard thick, applied and finished in an approved manner.

(15) TURBINES

(A) All heated surfaces shall be insulated with Ehret's 85% Magnesia Block or combinations of Ehret's 85% Magnesia Block and Ehret's Enduro Block with thicknesses as recommended in *Table 1.*

Any irregularities of the surfaces shall first be filled in and leveled over with insulating cement (Ehret's 85% Magnesia Cement to be used for temperatures not exceeding 600 deg. F. and Ehret's Enduro Cement for higher temperatures). The block is then to be fitted and firmly secured with $\frac{1}{8}$" wire cables and No. 16 gauge wire lacings. Over the wired-on blocks, 1" hexagonal mesh netting shall be stretched and secured, and a Cement (or Hard Cement) Finish applied.

All connections, flanges, valves, etc., on the turbine shall be insulated with the same materials and to the same thicknesses as that on the turbine itself.

(B) Alternate No. 1—Where certain specified sections of the turbine are to have removable insulation, Ehret's Asbestos Blanket Insulation, specially designed for thickness and shape, shall be furnished.

(C) Alternate No. 2—For a monolithic type of insulation, Ehret's Heat Seal Insulating Cement shall be applied to the same thicknesses as recommended for block-type insulation. The application shall be in $\frac{1}{2}$" thick layers with 1" hexagonal mesh netting stretched and secured over the last layer. A Cement (or Hard Cement) Finish should then be applied.

(16) HOT PIPING

All pipes carrying steam, hot water and condensate shall be insulated with Ehret's 85% Magnesia Pipe Covering or Ehret's Combination Enduro-85% Magnesia Pipe Covers, the thicknesses to be in accordance with *Table 2.*

TABLE 2

MINIMUM THICKNESSES FOR *INDOOR CONDITIONS

Temperature of Heated Surface, in Degrees, F.	PIPE SIZES							
	Under 2"		2" to 4"		4½" to 6"		7" and up	
	E	M	E	M	E	M	E	M
UP to 300	....	St.	....	St.	....	St.	....	St.
301 to 400	....	$1\frac{1}{2}$"	....	$1\frac{1}{2}$"	....	2"	....	2"
401 to 500	....	2"	....	2"	....	DS	....	DS
501 to 600	....	2"	....	2"	....	DS	....	DS
601 to 700	2"	.....	$1\frac{1}{2}$"	$1\frac{1}{2}$"	$1\frac{1}{2}$"	2"	$1\frac{1}{2}$"	2"
701 to 800	2"	.....	$1\frac{1}{2}$"	2"	$1\frac{1}{2}$"	2"	2"	2"
801 to 900	2"	.....	2"	2"	2"	2"	2"	$2\frac{1}{2}$"
901 to 1000	$2\frac{1}{2}$"	.....	$2\frac{1}{2}$"	2"	$2\frac{1}{2}$"	2"	$2\frac{1}{2}$"	$2\frac{1}{2}$"
1001 to 1100	$2\frac{1}{2}$"	.....	$2\frac{1}{2}$"	$2\frac{1}{2}$"	$2\frac{1}{2}$"	$2\frac{1}{2}$"	3"	2"

E—Enduro. M—85% Magnesia.
St.—Standard thick. DS—Double Standard thick.

*Where the insulation is to be applied on weather-exposed or extremely long lines, or where it is highly desirable to maintain temperatures or to minimize steam condensation, thicknesses should be at least $\frac{1}{4}$" greater than those recommended in the above table.

(A) Pasted and Banded Coverings

Single layer sectional coverings shall be applied with the laps of the factory-canvas jackets pasted down. For double layer sectional coverings the inner layer (which is not fur-

nished with a canvas jacket) shall be secured onto the pipe with No. 16 gauge annealed iron wire, the outer layer being placed over it with all joints staggered and the laps of the factory-canvas jackets pasted down. Segmental coverings shall have all layers secured in place with No. 16 gauge annealed iron wire and a 6-oz. canvas jacket smoothly pasted over the exterior surfaces with 3″ laps at all edges.

In all the above cases, where the piping is exposed, regulation factory metal bands shall be applied, one over each end joint and one over the mid-point of each section. Where the pipes are to be concealed, bands are not to be used but each section of covering shall be securely fastened with three loops of No. 16 gauge soft copper wire.

(B) Sewed Jackets

Where sewed jackets are specified, the general application details shall be the same as for "Pasted and Banded" applications, except that the bands shall be omitted and no canvas pasted over wired-on segmental outer layers. On sectional coverings at least three No. 16 gauge wire loops shall be placed around each length of covering, over the pasted-on factory jacket. The Sewed Canvas Finish shall then be applied, as described under Finishes in the General section of this specification, securely sewed with seams located where least visible.

(C) Fittings, Valves and Flanges

The insulation shall be of the same thickness as that on the adjacent piping. On pipe sizes 4″ and larger, Ehret's Block Insulation of the same material as that on the adjacent pipe shall be applied and firmly secured with No. 16 gauge annealed iron wire, allowing for a ½″ Cement Finish. For pipe sizes under 4″, an all-cement insulation shall be used consisting of Ehret's 85% Magnesia Cement for temperatures up to 600 degrees F. and Ehret's Heat-Seal Cement for higher temperatures. In all cases, a Cement Finish shall be applied over the insulation. Where there is to be a canvas finish it should conform to that on the adjacent pipe coverings.

(17) UNDERGROUND PIPING

The insulation and construction shall be in accordance with Ehret's Durant System of Pipe Line Protection. (See Ehret Data Sheets, series 300.)

(18) COLD WATER PIPING

Where such piping is not subject to exposure to freezing temperatures, it shall be covered with Ehret's Pipe Coverings in accordance with the thickness recommendations in *Table 3.*

For the 1″ and 1½″ thicknesses, Ehret's Anti-Sweat Pipe Coverings shall be applied. For greater thicknesses, Ehret's Wool Felt Pipe Coverings in double layer, staggered joint construction shall be applied. The jackets shall be sealed with Ehret's Waterproof Cement and bands applied, one over each end joint and one over the mid-point of each section of covering. Where there are to be sewed jackets, the bands shall be omitted and the coverings securely wired on, after which a Sewed Canvas Finish shall be applied.

All flanges, valves and fittings shall be covered with Ehret's Standard Hair Felt to approximately the same thickness as the coverings on the adjacent piping, secured with heavy jute twine in close wrappings and protected with a coating of Ehret's Fibrekote at least ½″ thick.

TABLE 3

Humidity	INSULATION THICKNESS for Temperature Differences—		
	50 deg. F.	60 deg. F.	70 deg. F.
up to 70%	1″	1″	1½″
70% to 80%	1½″	2″	2″
80% to 85%	2″	2½″	3″

(19) PROTECTION FROM FREEZING

Where pipes are to be exposed to freezing temperatures they shall be insulated with three 1″ thick layers of Ehret's Standard Hair Felt with wrappings of heavy tar paper on the piping and between each layer of hair felt. Each layer shall be secured with strong jute twine at 1″ spacings and an outside layer of tar paper shall then be applied and fastened on with separate loops of No. 16 gauge Copperweld wire at 4″ spacings. (A Sewed Canvas Finish may, if desired, be specified here.)

On small size pipes, where cold conditions are not likely to be severe, Ehret's Frostproof Pipe Coverings, 1¼″ thick, shall be used.

(IV) VENTILATING AND AIR CONDITIONING

(20) WARM AIR DUCTS

The insulation shall consist of Ehret's 85% Magnesia Block, 1½″ thick, attached to the metal surfaces with Ehret's Fibrous Adhesive and secured by means of ⅛″ wire cables and wire lacings. The bottoms of the ducts shall be provided with anchors to prevent the insulation from sagging. A Cement (or Hard Cement) Finish shall then be applied over the insulation. After the Cement Finish is dry, a Sewed Canvas Finish shall be applied (specify weight of canvas).

(21) COLD EQUIPMENT AND DUCTS

(A) Hair Felt Insulation

Two layers of 1″ thick Ehret's Standard Hair Felt shall be applied on the equipment and one layer of 1″ thick on the ducts. In the two layer construction the inner layer shall be secured with wrappings of heavy jute twine and the second layer applied over a wrapping of tar paper. The second layer of hair felt, as well as the singly applied layer, shall be secured by separate loops of No. 16 gauge Copperweld wire at 3″ spacings. A Sewed Canvas Finish shall then be applied, (specify weight of canvas).

(B) Cork Insulation

The equipment shall be insulated with two layers of 1″ thick Ehret's Corkboard and the ducts with one layer of 1″ thick. All Corkboard layers shall be attached with a strong adhesive cement and then further secured with loops of No. 16 gauge Copperweld wire at about 1 foot spacings. All joints shall be filled with a waterproof sealing cement.

(V) PLUMBING

(22) RESIDENTIAL RANGE BOILERS

An Ehret's Flexible Range Boiler Jacket of the proper size and finish shall be applied with the instructions that accompany the materials.

(23) HOT WATER HEATER AND STORAGE TANK

The insulation shall consist of Ehret's 85% Magnesia Block, 1″ thick, secured with ⅛″ wire cables and No. 16 gauge annealed iron wire. Two inch hexagonal mesh netting shall be stretched and secured over the applied Blocks and a Cement (or Hard Cement) Finish shall then be applied.

(24) HOT WATER SERVICE PIPING

The insulation shall be Ehret's 85% Magnesia Pipe Covering, Standard Thick, with the laps of the factory-canvas jackets pasted down and then further secured by means of one metal band placed over each joint and one band over the mid-point of each section. (Where sewed jackets are specified, omit the bands and apply a Sewed Canvas Finish of specified weight.)

Flanges, valves and fittings shall be insulated with Ehret's 85% Magnesia Cement, covered with a Cement Finish, the total thickness to be the same as that of the insulation on the adjacent piping. When there is to be a Canvas Finish it should conform to that on the adjacent pipe covering.

(25) COLD WATER SERVICE PIPING

(See specification as given under "General Heating and Power, Par. 18).

(26) CHILLED OR ICE WATER PIPING

(A) Hair Felt Insulation

On the larger sized pipes, apply Ehret's Standard Hair Felt 1" thick and secure it in place with wrappings of heavy jute twine at 1" spacings. A Sewed Canvas Finish of 8-oz. enamelling duck shall then be applied in the specified manner. Small sized pipes shall be insulated with Ehret's Frostproof Pipe Coverings.

Flanges, Valves and fittings shall be insulated with Ehret's Standard Hair Felt, 1" thick, secured by close wrappings of strong jute twine and then completely covered with a layer of Ehret's Fibrekote at least ¼" thick, trowelled smooth.

(B) Cork Insulation

The piping and all fittings shall be insulated with Ehret's Ice Water Thickness Cork Insulation, secured with Copperweld wire and sealed with waterproof cement. All outer surfaces shall then be given a coat of Ehret's Cork Covering Paint.

(27) LEADERS AND DOWN DRAINS

The insulation shall consist of 3 layers of Ehret's Standard Hair Felt, each 1" thick, secured by wrappings of heavy jute twine on 1" spacings. Heavy tar paper is to be wrapped on the metal surfaces, between each layer of Hair Felt and over the outer surface of the Hair Felt. Over the last layer of tar paper there shall be separate loops of No. 16 gauge Copperweld wire at 4" spacings.

(28) TO PREVENT FREEZING

(A) Pipes and equipment are to be covered with 3 layers of Ehret's Standard Hair Felt, each 1" thick, with layers of heavy tar paper on the metal surfaces and between each layer of Hair Felt. Each layer shall be secured with wrappings of heavy jute twine. An outer layer of heavy tar paper is then to be applied and securely held in place with No. 16 gauge Copperweld wire. (A Sewed Canvas Finish may be specified if so desired.)

(B) Alternate—On small size pipes, where cold conditions are not severe, Ehret's Frostproof Pipe Coverings, 1¼" thick, shall be applied in an approved manner.

(VI) REFRIGERATION

(29) PIPING

(A) Hair Felt Insulation

The Hair Felt shall be applied in multiple layers in accordance with the recommendations given in *Table 4.*

TABLE 4

HAIR FELT INSULATION

Temperature range in Degrees F.	Total Thickness of Insulation
15 to 50	2" (2–1" layers)
zero to 15	3" (3–1" layers)
–20 to zero	4" (4–1" layers)
–40 to –20	5" (5–1" layers)
–60 to –40	6" (6–1" layers)
–80 to –60	8" (4–1" and 2–2" layers)
–100 to –80	10" (4–1" and 3–2" layers)
–120 to –100	12" (4–1" and 4–2" layers)

The insulation shall be built up in separate layers, each layer being secured with heavy jute twine on 1" spacings. On the pipe surfaces, between each Hair Felt layer and over the outer surface of the last layer, shall be a wrapping of heavy tar paper. The outer layer of tar paper shall be wrapped with separate loops of No. 16 gauge Copperweld wire, at 4" spacings. (Specify Sewed Canvas Finish of the proper weight, if desired.)

When the most efficient and dependable method of applying Hair Felt is desired, the following applies: The layers of tar paper over each layer of Hair Felt shall be omitted, and instead, each layer shall be sealed with heavy coatings of a waterproof sealing compound (or by spiral wrappings of a special heavy self-sealing tape).

Flanges, fittings and valves are to be insulated in the same manner as the adjacent piping.

(B) Cork Insulation

All piping, flanges, valves and fittings shall be insulated with Ehret's Cork Insulation in accordance with the service recommendations in *Table 5.*

TABLE 5

CORK INSULATION

Temperature Degrees F.	Designated Service	Thickness in Inches
Above 25	Ice Water	1½ to 2
Zero to 25	Brine	2 to 3
Below zero	Heavy Brine	3 to 4

All molded shapes shall be applied and finished in accordance with the recommendations made on Ehret Data Sheet No. HCI 420.

(VII) WEATHERPROOFING

(30) DURANT SYSTEM

Insulated piping that is to be exposed to the weather or buried underground shall be protected by Ehret's Durant System of Pre-Sealed Pipeline Protection. (See Ehret Data Sheets, series 300.)

(31) MEMBRANE TYPE

Insulated piping and equipment that is to be exposed to the weather shall be protected as follows:

A wrapping of Ehret's 55-lb. asphalt-saturated-and-coated Roofing Felt shall be applied over the flat or simple-curved surfaces of the applied insulations, allowing at least 3" laps at all edges and joints. These laps shall be sealed with Ehret's Asphalt Sealing Compound and separate loops of No. 16 gauge Copperweld (or copper) wire shall be firmly fastened around the weatherproofing on pipe coverings at equal spacings of not more than 6 inches.

Odd-shaped equipment, including flanges, valves and fittings shall be protected with Ehret's Fibrekote, at least ¼" thick, that is trowelled on smoothly and lapped over onto the adjacent roofing felts for a minimum of 2".

(32) PLASTIC TYPE

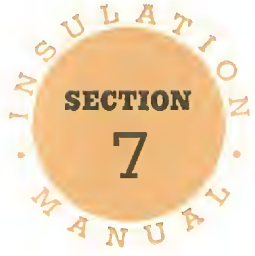
Ehret's Fibrekote, at least ¼" thick, shall be applied to all surfaces and trowelled to a smooth finish.

When the application of Fibrekote is to be made on Cork insulation, Ehret's Fibrekote Primer shall be used before the Fibrekote is applied.

When the Fibrekote is to be used on metal surfaces, Ehret's Fibrekote Primer and Waterproofing Membrane shall be used in an approved manner to provide a waterproof bond between the Fibrekote and the metal surface.

EHRET

REFRACTORY CEMENTS



EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. RC 500

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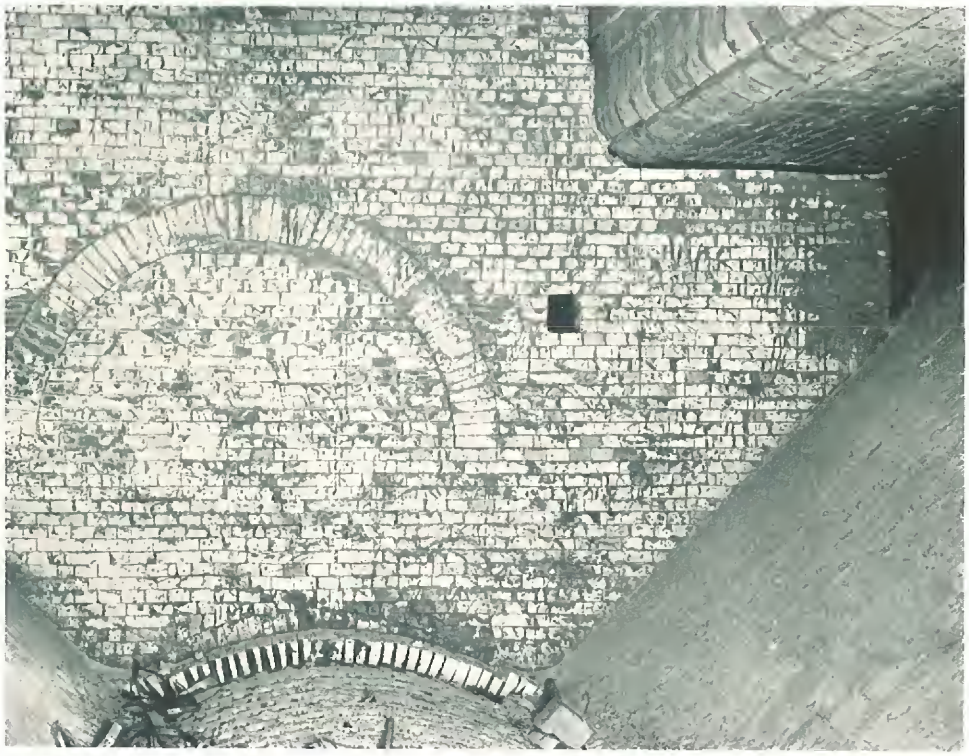
EHRET
INSULATIONS

The refractory cement used in laying up the brick in this boiler setting is Ehret's Emmco. A brush coating will further protect this installation to insure long, efficient service life.



EHRET'S REFRACTORY CEMENTS

Refractory cements are used throughout industry for laying up fire brick in boiler furnaces, kilns, retorts, industrial furnaces, and numerous other types of high temperature equipment. Although used mainly as a bond for fire brick in linings, fire walls and baffles, refractory cements are also used as a wash-coat over the entire brickwork surface and as a repair material for maintaining damaged brickwork.

Carefully compounded from high-grade materials, Ehret's Refractory Cements are made in a variety of types for various services. Ehret's Refractory Cements will not swell, shrink, lose strength, or disintegrate at recommended temperatures, and they maintain their bond throughout their complete temperature range. Fire brick begin to soften at about 500° below their melting point and, if the edges and corners are not protected, they are prone to spall at these points. A good refractory cement permanently seals the fire brick joints and confines the direct action of the heat to one surface only of the brick, thus retarding the spalling action and greatly prolonging the life of the structure.

When brickwork in boiler furnace installations is bonded with Ehret's Refractory Cement, air infiltration is practically eliminated, boiler efficiency is increased, and fuel savings result. Insulation behind the brickwork or steelwork forming the furnace bindings is protected from direct flame action and furnace gases. The temperature gradient through the brickwork is more uniform, which reduces the tendency of the brick to spall.

Brush-coating of fire brick construction with the proper Ehret Refractory Cement will greatly prolong the service life of the installation. The pores of the brick are sealed and the entire surface of the brickwork presents a smooth surface. Gas and flame erosion, clinker adherence, spalling and disintegrating of the fire brick are all greatly reduced.

Repairs to damaged brickwork in boiler furnace walls, fire walls, and baffles can often be made with Ehret Plastic Fire Brick. The damaged section needs but to be cleaned out and the plastic material keyed in the cavity and rammed flush with the surface.

Where a castable refractory material is required Ehret's Castable should be used. Such uses include linings for fire and furnace doors and flues, and permits the casting of monolithic baffles and the making of all types of special shapes.

In furnishing a line of refractory products to meet practically every type of high temperature requirement, a constant effort has been maintained to hold the number of products to a practical minimum. Ehret Refractory Cements, Castables, and Plastics are adaptable to a wide range of operating and service conditions and this, naturally, simplifies the problem of specification.

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PROPER USE OF REFRACTORY CEMENTS . . .

To insure full economy and maximum results, a refractory cement should be carefully chosen, properly mixed, and correctly used or applied. Refractory brickwork is no better than the cement used to bond it and shut-downs for repairs or replacements are costly.

In general, a cement should be either neutral or similar in composition to the brick it is to be used with. Ordinary fire clay mortars, however, should not be used for bonding fire brick as they do not provide good bond and are subject to shrinking, crumbling, and disintegrating. In actual use a cement should show little permanent shrinkage or expansion over its entire firing range.

The working properties of a high temperature cement are of primary importance to the brick-mason. A smooth-flowing cement of maximum coverage permits the making of thin, dipped joints which insure gas-tight construction. Neither should it creep when thick joints are used.

In wash-coating, trowelling, gun application, and monolithic work, the proper sizing and grading of the grain particles is of major importance.

The brush-coating of firebrick construction with the proper refractory cement is an economical means of prolonging the life of the brickwork. The edges and even the pores in the brick are sealed and protected against the destructive action of flame, gases, and slag. Spalling is decreased and the tendency of slag or clinkers to adhere to joints or surfaces is minimized. A brush-coating of the proper refractory cement is one of the best ways to preserve exposed surfaces.

Refractory surfaces can also be applied with either trowel or cement gun. The application can be made as a veneer or used to patch damaged brickwork.

Castable refractories can be mixed, poured, rammed and handled the same as cement-concrete to form precast shapes as well as complete monolithic construction.

The cost of the refractory cement used in any installation is so small as compared to the total cost of the installation that it is not good economy to purchase this product on a price basis only.

Fire Clay is a low-cost material but, if used as a mortar for bonding brick, it is likely to prove very expensive. It has high drying and firing shrinkage and has comparatively little bonding power.

The Ehret Refractory Products, briefly described in the table below, are all compounded and prepared with a view to providing maximum service economy.

EHRET REFRACTORY CEMENTS

Product	Form	Base	Type of Setting	Temp. Limit	Description or Use	Packaging
EMMCO Cement	Plastic	Aluminum Silicate	Air-set	2700°F.	General purpose—finely milled—for thin or thick brick joints, brush-coating, veneers.	5, 25, 100, 250, 500 lb. metal containers.
No. 300 Cement	Dry	Aluminum Silicate	Air-set	3000°F.	For bonding brick, dipped or trowelled joints, wash-coating with brush, trowell or gun.	100 lb. paper-lined burlap bags.
No. 315 Cement	Dry	Aluminum Silicate	Heat-set	3100°F.	Where thick cushion joints in large, heavy wall structures are desired. Develops high modulus of rupture at room temperatures.	100 lb. paper-lined burlap bags.
No. 345 Chrome Cement	Dry	Chrome	Air-set	3300°F.	For high temperature work, thin or trowelled joints, brush or trowelled coatings and patching. Highly resistant to chemical action.	200 lb. metal drums
No. 355 Chrome Cement	Plastic	Chrome	Air-set	3300°F.	(Same as described for No. 345 Chrome Cement.)	250 and 500 lb. metal drums.
Hearth Castable	Dry	Aluminum Silicate	Hydraulic-set	2400°F.	A strong, shock-resistant material used for molding or pouring hearths, floors, and special shapes. Well suited for domestic oil burner applications.	125 lb. paper-lined burlap bags.
No. 25 Castable	Dry	Aluminum Siiicate	Hydraulic-set	2500°F.	Excellent strength, used for casting door liners, baffles, ducts, heads, burner blocks and special shapes.	125 lb. paper-lined burlap bags.
Plastic Fire Brick	Plastic	Aluminum Silicate	Air-set	3100°F.	For monolithic linings and patching damaged fire brick walls. Forms ceramic bond at 1500°F.	100 lb. cartons. 100, 200 and 500 lb. metal drums.
Chrome-Cote	Plastic	Chrome	Air-set	3200°F.	A high temperature surfacing material for veneering fire brick construction. Resists flame and slag.	100 and 250 lb. metal drums.
Chrome Hearth Refractory	Plastic	Chrome	Air-set	3300°F.	For making monolithic hearths in forging, heating, sheet and plate furnaces. Resists slag penetration.	250 lb. metal drums.
Chrome Aggregate	Dry	Chrome	.....	3300°F.	A dry material for mixing with Emmco or No. 355 Chrome Cement.	125 lb. paper-lined burlap bags.
Chrome Ore Grog	Dry	Chrome	.....	3300°F.	Same as Chrome Aggregate, but coarser. To be used with No. 345 Chrome Cement for forming hearths and for forging and billet-heating furnaces.	125 lb. paper-lined burlap bags.

Revolving hearth and brickwork in a rotary-type annealing furnace, laid up with Ehret's Emmco Cement.

EMMCO CEMENT

A general purpose, fine-grained, air-setting, aluminum silicate cement. It is gray in color and is furnished in plastic form, prepared ready for use. Emmco Cement retains its strong bond throughout its complete temperature range to plus 2700°F.

Because of its smooth consistency, Emmco Cement permits the making of thin, dipped or brick-to-brick joints so necessary for tight, durable construction. When the construction is completed, a brush coating of Emmco Cement is strongly recommended to fill the pores and any small voids in the brickwork.

In setting standard size bricks, approximately 400 to 450 pounds of Emmco Cement will be required per 1000 brick, dipped joints. For brush coating, 40 pounds of Emmco Cement, thinned with water to a cream-like consistency, will cover approximately 100 square feet of surface.

For heavier veneers and for coating baffles, we recommend a mixture of 2 parts Emmco Cement, 3 parts Emmco Chrome Aggregate, and 1 part water, applied with either trowel or gun.

Patching of damaged brickwork may be done with a mixture of 40% Emmco Cement and 60% crushed fire brick (all passing 6 mesh screen, including fines). The hole to be repaired should be undercut, filled with the above suggested mix, and rammed into place.

Packaging

Furnished in plastic form, Emmco Cement is packed in metal containers with net weights of 5, 25, 50, 100, 250, and 500 pounds.

No. 300 CEMENT

This cement is a general purpose, dry, air-setting cement made from an aluminum silicate base and has a working temperature limit of 3000°F. It is finely milled and has practically no drying or firing shrinkage. Bonding characteristics are excellent and it may be used for making dipped, as well as trowelled, joints.

In addition to being used for bonding brickwork, Ehret's No. 300 Cement can be applied as a wash-coating with brush or trowel. For thicker surfacings applied with the gun, we recommend it be mixed with equal parts of Emmco Chrome Aggregate or any other calcined aggregate passing a 12 mesh screen.

For dipped joints, 400 to 450 pounds of No. 300 Cement will set 1000 standard brick. For wash coating, 35 pounds of cement mixed with water to a paint-like consistency will cover approximately 100 square feet of fire brick surface.

Preparation

Mix with fresh water (preferably hot) when possible an hour or two before using. Only a small amount of water should be added at a time and each lot should be thoroughly mixed before additional water is added. Never add entire quantity of water at one time and never use excessive amount. For trowelled joints, reduce to batter-like consistency, and for dipped joints it should be slightly thinner.

Patching can be satisfactorily accomplished by mixing equal parts of No. 300 Cement with crushed fire brick, all passing 6 mesh screen. The hole to be filled should be thoroughly cleaned and a key cut in the brick before the material is packed and rammed into place.

This cement finds wide usage in equipment such as boiler settings, both pulverized fuel and stoker-fired, and for forge and billet heating furnaces.

Packaging

Ehret's No. 300 Cement is furnished in dry form, in 100 pound, paper-lined burlap bags.

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No. 315 CEMENT

This dry cement is especially suited for large and heavy wall structures where thick cushion joints are desired to permit the free movement of brick and allow for thermal expansion during the heating-up period. This cement will make joints having a high modulus of rupture at room temperatures and at 1800°F. a strong ceramic bond is formed that extends deeply into the joints.

Ehret's No. 315 Cement has an aluminum silicate base, is heat-setting, and permits a working temperature up to 3100°F. plus. For trowelled joints estimate approximately 500 pounds per 1000 standard 9" brick.

The method of preparation is the same as for Ehret's No. 300 Cement.

Packaging

Ehret's No. 315 Cement is packed in paper-lined, burlap bags of 100 pounds net weight.

No. 345 CHROME CEMENT

This cement is made from a chrome base and is suitable for use with temperatures up to plus 3300°F. It is furnished in dry form and needs but to be mixed with water to obtain the desired consistency. It is air-setting and has, when dried, excellent bonding strength. It is specifically recommended for laying up and coating brickwork of industrial and boiler furnaces where extremely high temperatures and chemical reactions are encountered. This cement is so inert it can be used for laying up practically any kind of refractory brick including clay, high alumina, chrome and magnesite brick with either dipped or thinly trowelled joints. The unusually high heat resistance and neutral chemical characteristics of Ehret's No. 345 Chrome Cement are particularly adapted for use in all types of melting and industrial furnaces including soaking pits, open hearth, billet-heating, and forging furnaces. Its density and neutral qualities insure its resistance to abrasion, slag penetration, and most chemical reactions.

Estimate approximately 450 to 500 pounds of No. 345 Chrome Cement per 1000 brick for dipped joints and 650 pounds for trowelled joints.

Preparation

Ehret's No. 345 Chrome Cement should be prepared in a water-tight mortar box, cleaned of old clays and other mortars. Mix with water, preferably hot, (when possible, an hour or two before using) until desired trowelling or dipping consistency has been obtained. Add water slowly and mix thoroughly with hoe.

Coatings

Thin brush coatings of Ehret's No. 345 Chrome Cement seal joints and pores of newly-built brickwork which will be exposed to flame or erosive gases. For use in this manner, prepare the cement in the same manner as for dipping and apply thinly with a brush. Thicker coatings of Ehret's No. 345 Chrome Cement alone, or when mixed with Ehret's Chrome Aggregate or other refractory materials of correct grain size, can be applied with either gun or trowel.

Patching

For patching and repairing burned-out sections of brickwork in all types of furnaces, use the hearth formula but substitute crushed brick bats in place of Ehret's Chrome Grog.

Furnace Hearths

For making monolithic hearths in forging or heating furnaces, use a mixture of 40% Ehret's No. 345 Chrome Cement and 60% Ehret's Chrome Grog. Add sufficient water, preferably hot, to give proper consistency.

Packaging

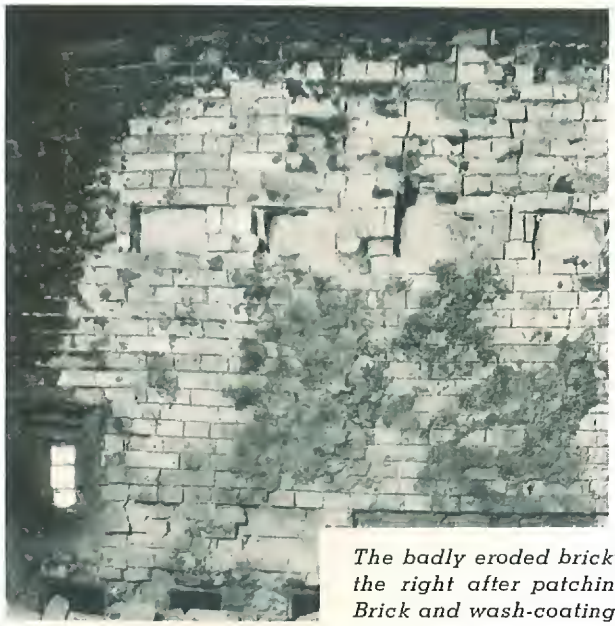
Ehret's No. 345 Chrome Cement is shipped in 200 pound metal containers.

No. 355 CHROME CEMENT

This material is similar in all respects to Ehret's No. 345 Chrome Cement, excepting that it is furnished in plastic form, prepared ready for use. It is of the proper consistency for trowelling and, if desired, can be reduced with water to dipping consistency.

Shipped in steel drums of 250 and 500 pounds net weight.

At the left is shown a stoker-fired boiler furnace laid up and coated with Ehret's Chrome Cement.



The badly eroded brickwork at the left is shown at the right after patching with Ehret's Plastic Fire Brick and wash-coating with Ehret's Chrome-Cote.

PLASTIC FIRE BRICK

Ehret's Plastic Fire Brick can be used for making monolithic linings and for patching fire brick settings. This material develops a strong modulus of rupture at room temperatures, forms a ceramic bond at about 1800°F., and can be used with temperatures up to 3100°F.

In using Ehret's Plastic Fire Brick to patch damaged brickwork, all burned and loose particles should be removed and the surface dampened with water. Undercut the old lining in order that the plastic may be keyed into place, then tamp in the plastic and smooth the surface flush with the rest of the wall. Where the patches are small, the equipment may be brought up immediately to operating temperatures but, where the patches are large and for monolithic construction, first dry out with slow fire. Minimum thickness of patches and monolithic construction should be at least 4". Approximately 133 pounds of plastic are required for each cubic foot.

Packaging

Ehret's Plastic Fire Brick is shipped in 100 pound cartons, 100, 200 and 500 pound metal containers. (After opening package, unused contents should be thoroughly dampened and stored in a cool place.)

HEARTH CASTABLE

This castable refractory is widely used in molding or pouring hearths and floors and for making special shapes for domestic oil burner installations. It is furnished in dry form and requires only the addition of water to prepare for casting. After setting, Ehret's Hearth Castable weighs approximately 115 pounds per cubic foot and is hard, structurally strong and highly resistant to thermal shock. It is recommended for use with temperatures up to 2400°F. and is furnished in paper-lined, burlap sacks of 125 pounds each.

No. 25 CASTABLE

This is a castable refractory product which will enable you to make special fire clay shapes if and when you want them and at a low cost. It is furnished in dry form and requires only the addition of water to permit the casting of monolithic door liners, dampers, headers, baffles, furnace ducts, and for making burner blocks and irregular shapes. Made from an aluminum silicate base, Ehret's No. 25 Castable is hydraulic-setting and does not shrink or crack during the hardening process. When thoroughly set, it has excellent mechanical strength and is highly resistant to cracking and spalling.

For pouring or casting, No. 25 Castable, 2½ to 3 gallons of clean water should be added to each 125 pounds of dry material. Difficult pours into intricate shapes, however, may require slightly more water. To obtain a stiffer mix for tamping or ramming, use only 2 gallons of water to each 125 pound bag.

In casting shapes of No. 25 Castable, it is recommended the minimum thickness of any part of the casting should be no less than 1½". The weight of the set and dried material is approximately 115 pounds per cubic foot.

Recommended temperature limit—2500°F.

Packaging

Ehret's No. 25 Castable is furnished in paper-lined, burlap bags of 125 pounds net weight.

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CHROME-COTE

Ehret's Chrome-Cote is a neutral and superior refractory surfacing material, used as a veneer on fire brick construction to resist scorifying flame action and slag penetration. Ehret's Chrome-Cote is shipped in plastic form and requires further thinning with water to obtain a batter-like consistency for brush-coat applications.

To obtain maximum results, coating should not be applied greater than $\frac{1}{8}''$ to a maximum of $\frac{3}{16}''$ thick and generally a $\frac{1}{16}''$ coating is preferable. Application of too thick a coating at one time should be avoided. Thinner coatings applied at frequent and periodic intervals will be found much more effective.

Ehret's Chrome-Cote, when properly applied on clean walls, forms a veneer that will adhere tightly to the brick, and spalled and eroded sections can be gradually built up.

The structure to be coated should first be cleaned of all dust, clinker, and loose ash. Slag should be cleaned off back to the brick. If not hot, wet down with water.

After Ehret's Chrome-Cote has been reduced with water to a thick, paint-like consistency, application should be made using a vertical and stippling stroke with the brush.

Do not attempt to apply entire thickness of coating at one time; within an hour the first coating will be sufficiently dry to permit a second application. 100 pounds will cover 100 square feet, $\frac{1}{16}''$ thick. Ehret's Chrome-Cote is shipped in air-tight, steel containers of 100 and 250 pounds net.

The use of Ehret's Refractory Cements insures tight joints that protect the brickwork for months of extra service.

CHROME HEARTH REFRACTORY

Ehret's Chrome Hearth Refractory is a chemically neutral refractory compounded into a plastic form for use in constructing monolithic hearths in forging, heating, sheet and plate furnaces, and in boiler furnaces equipped with slag tap bottoms. Ehret's Chrome Hearth Refractory has low porosity, high density, and is resistant to penetration of either slag or molten metal.

Ehret's Chrome Hearth Refractory, installed in forging furnaces, insures cleaner forgings and a faster working furnace. Can be installed in less time than fire brick and has a much longer life. Ehret's Chrome Hearth Refractory, as shipped, has the proper consistency, is crumbly in the hands but compactible under pressure. It should be tamped in firmly and layers built up for given thicknesses. Bottoms should never be less than 4" thick.

Estimate 200 pounds of Ehret's Chrome Hearth Refractory to fill 1 cubic foot.

Ehret's Chrome Hearth Refractory is shipped in 250 pound, air-tight, steel drums.

CHROME AGGREGATE

This is a carefully prepared, chromite base material compounded of ingredients which will pass a 16-mesh screen. This material does not contain sufficient bonding agent to be used alone but must be mixed with the proper proportion of Emmco Cement as the binder.

For surface coatings under normal furnace conditions, the following mixture has proven most generally serviceable:

2 parts (by volume) Emmco Cement
3 parts (by volume) Ehret's Chrome Aggregate
1 part (by volume) water

Where service conditions are particularly severe, Ehret's No. 355 Chrome Cement can be substituted in place of Emmco Cement.

Shipped in 125-lb. paper-lined, burlap bags.

CHROME ORE GROG

This is similar in characteristics to Ehret's Chrome Aggregate excepting that some of the particles are larger in size. It is recommended for use in the construction of monolithic hearths in forging or billet-heating furnaces and should be combined with Ehret's No. 345 Chrome Cement in the following proportions:

Ehret's No. 345 Chrome Cement . . 40%
Ehret's Chrome Ore Grog 60%
Add sufficient water (10% to 12%), preferably hot, to reduce to moldable consistency.

Shipped in 125-lb. paper-lined, burlap bags.

EHRET

VALLEY FORGE
PACKINGS

INSULATION MANUAL

SECTION
8

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. P 525

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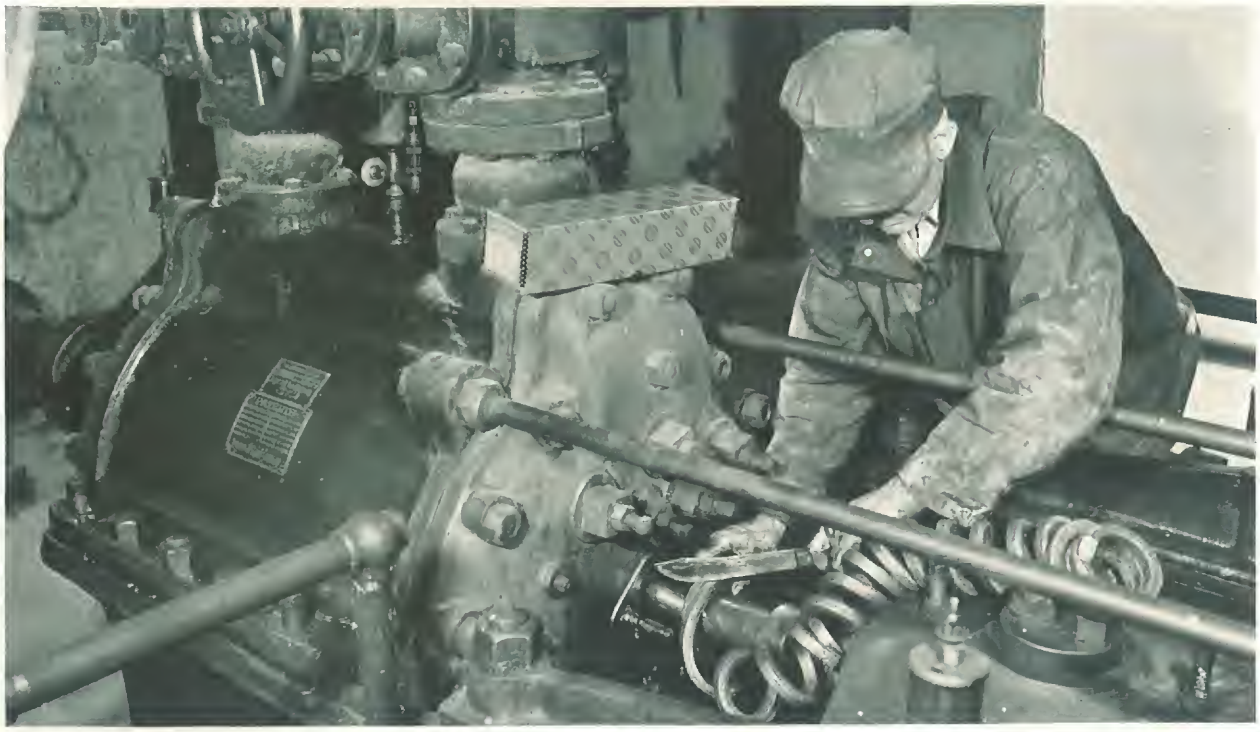
EHRET
INSULATIONS



EHRET'S VALLEY FORGE PACKINGS

Packings are used to minimize or prevent the passage of fluids under pressure through joints or bearings. The use of packings in industry is so wide and so varied as to have resulted in the development of a broad range of materials in a great variety of styles, constructions and sizes.

There is available today a packing for practically every purpose. So many different packing styles, types and materials are offered in such a variety of forms that the problems of the packing buyer are frequently complicated by the number of materials from which to choose.

It has been with a view to simplifying some of the problems that face the buyers and users of packings that the line of Ehret Packings has been developed.

In the manufacture of Ehret Packings, high quality materials are fabricated, by modern methods and skilled workmen, into products that are especially suited for one or more particular services. In designing and producing these packings, the number of different items has been held to a minimum consistent with service economy and good practice. By holding the number of Ehret packing types and styles to a relatively low figure, users that have a broad range of packing service requirements need only stock a minimum number of items.

To further reduce inventory requirements on the part of packing users, the Ehret Company, through their approved distributors and jobbers, carry complete stocks of packings from which needs can be answered on short notice. This prompt filling of packing users requirements is but one phase of the Ehret Packing service to industry.

The quality of a packing material is naturally of considerable importance. Of equal importance, however, is its proper use, application and maintenance. An excellent packing, if installed on a service for which it is not best suited, may result in premature failure, costly servicing and shutdowns or possible damage to the equipment on which it is used. Improper installation, the wrong size or the wrong amount of material, can result in much trouble and expense, even though the packing itself be of the correct general type.

As a means of assisting users with their problems relating to the choice, installation and maintenance of packings, the Ehret Company provides a complete packing service. In addition to stocking and promptly supplying desired materials, our packing specialists regularly assist in the solution of maintenance problems and in lowering costs. This service includes, for those who wish it, surveys of individual packing usage and requirements, and such surveys are frequently followed by recommendations that lead to substantial service improvements and cost reductions. This Ehret packing service is available on request, to those who wish to assure themselves of full economy in the selection, use and maintenance of mechanical packings.

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EHRET
INSULATIONS

PACKING COSTS AND MAINTENANCE

The price per pound is but one of several factors that need to be considered in arriving at the true cost of packings. Service life, maintenance and lubrication requirements, shut-down expense and the wear on moving parts are usually of greater economic importance than the first cost of the packing materials used.

Frequently there are hazards that can be reduced by the proper use of good packings. For example, a packing failure on a refrigerating unit can result in spoilage of perishable products. Likewise, untimely packing failures on processing equipment of a critical nature can result in costly damage to materials being processed. Losses such as these have been known to range up into large figures. From a true cost standpoint, it is advisable to purchase packings on a basis of dependable quality and service.

The efficiency and service life of any packing depends to a great extent on the proper selection of size and material as well as the correct installation. The following general suggestions may be of interest to those who are responsible for the installation and maintenance of packings.

Maintenance Suggestions

The packings used should be clean and free from dirt, dust and grit. Packing materials that have been carried in stock for a long time should be carefully inspected to make sure that they have not hardened or deteriorated.

Before installing any type of packing, all old packing should be removed and the surfaces thoroughly cleaned. Rods and plungers should be checked frequently for size, smoothness and alignment, and where the condition of the equipment is not satisfactory, repairs or adjustments should be made. There are packings designed specifically for use on worn equipment and these special packings should be used where it is impractical or impossible to make needed mechanical repairs.

Most rod packing is purchased in spiral form. Spirals are convenient for cutting, without waste, into rings to fit various size rods. In cutting rings from spirals, care should be taken that they are cut to exactly the proper size. If cut too large, there is likely to be buckling or overlapping which lessens the packing efficiency and life. If rings are cut too small, the installation will probably leak.

Rings cut from solid packing should have either butt or diagonal joints. In most cases, either type of joint will give satisfactory results, but in soft packings butt joints only should be used.

Before installing packing rings on rods or shafts, lubrication of the proper type should be applied to the metal surfaces. Rings should be inserted with the joints staggered and each ring should be firmly seated against the next. The packing gland should be placed over the last ring and drawn up tight with the packing gland nuts. These nuts should then be backed off and drawn up finger-tight, with a quarter turn of the wrench to hold them. In cases where plastic packing is used, end rings of the proper fabric material should always be installed.

All packings expand or contract to some degree with temperature changes. Where packed equipment is subject to a wide range of temperatures, as in the case of steam pumps, ammonia compressors, etc., it is highly desirable to make adjustments to the packing gland nuts during the temperature change.

It is recommended that packings used on rotary equipment be of braided construction wherever possible, as this type of packing gives a soft, snug fit and carries considerable lubrication to assist in holding friction heat to a minimum.

On steam and hot water pumps, new packings sometimes cause trouble because of the expansion that takes place when saturated. In such cases the packing gland should be slacked off from time to time to prevent the swelling of the packing from causing undue pressure on the gland, shaft or rod.

Before pipe flange gaskets, boiler manhole and handhole gaskets are installed, the metal surfaces should be carefully cleaned. Pipe flange gaskets should have an inside diameter large enough to prevent the gasketing material from extending beyond the inside limits of the flange. Manhole and handhole gaskets should be applied with care so that no wrinkling, buckling or folding takes place as the bolts are drawn tight. After new gaskets have been applied on hot or cold piping and equipment, bolts should be tightened during the temperature change to service conditions so as to prevent leakage.

It is highly important that flange bolts be drawn up evenly around the pipe. Most flange gasket failures are attributable to uneven tension on pipe flange bolts.

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The experience of Ehret packing specialists is available to those who desire assistance in the solution of either routine or special packing problems. Our engineers will be glad to work with you in lowering packing costs and improving packing service. This cooperation is provided, without obligation, as a part of the Ehret Packing Service to Industry.

PACKING RECOMMENDATIONS FOR STANDARD EQUIPMENT

Ehret packing numbers listed in the tables on this sheet are arranged in order of general preference for the particular services

Type of Packing	STEAM		Hot Water	COLD WATER		Hot Oil	Cold Oil	Gasoline	Asphalt, Pitch or Tar	Ammonia	Acids	Caustics	Air	Air Pumps	Natural Gas
	High Pressure	Low Pressure		High Pressure	Low Pressure										
RECIPROCATING RODS, VALVE RODS, PLUNGERS AND RAMS															
Fibrous	A-01 A-04 A-18 A-92	D-02 D-09 D-06 D-17 D-20	D-09 D-02 D-12 D-06 D-17	F-03 F-00 F-60 D-09 D-17	F-00 F-07 F-60 F-15 D-20	A-70	A-70 A-18	A-28 A-72	A-70 M-26	D-56 D-09 D-06	A-65 A-54	A-56 A-18	A-02 A-15 A-10 A-18	C-70 C-71	A-89 A-18 A-15
P K Sets	078	068	568	068	068	178	168	068	178	068	. . . . .	. . . . .	078	078	078
Semi-Metallic	1000	1000	1001	1001	1001	1002	1002	. . . . .	1006	1004	1003	1005			
Plastic	No. 2 No. 1	No. 1	No. 1	No. 1	No. 1	No. 2	No. 1	No. 4	No. 1	No. 1	No. 6	No. 1	No. 1	No. 1	No. 1
ROTATING SHAFTS AND RODS															
Fibrous	A-12 A-09	A-12 A-09 A-18	A-12 A-09	A-12 A-09 F-03	A-12 A-09 F-03	A-70	A-70	A-30 A-28	A-70	A-12 A-18 D-56	A-67 A-65	A-58 A-12	A-12 A-18	. . . . .	A-12 A-18
Semi-Metallic	1000	1000	1001	1001	1001	1002	1002	. . . . .	1006	1004	1003	1005			
Plastic	No. 2 No. 1	No. 1	No. 1	No. 1	No. 1	No. 2	No. 1	No. 4	No. 1	No. 1	No. 6	No. 1	No. 1	No. 1	No. 1
VALVE STEMS															
Fibrous	A-24 A-68 A-90 A-25	A-25 A-26	A-68 A-25 A-26	A-68 A-25 A-26	A-25 A-26 A-12	A-70 A-79	A-70 A-28 A-12	A-28 A-72 A-77	A-70 A-24	A-68 A-25 A-26	A-65 A-47	A-56 A-24	A-25 A-26	. . . . .	A-68 A-24
Plastic	No. 2 No. 1	No. 1	No. 1	No. 1	No. 1	No. 2	No. 1	No. 4	No. 1	No. 1	No. 6	No. 1	No. 1	No. 1	No. 1
PIPE FLANGES AND FITTINGS															
Sheet or Gaskets	80 81 83	81 405 40 45	40 45	405 40 50	40 50 51 52	82 85	45 85	53 82 84	82 85	80 82	. . . . .	. . . . .	80 405 40	. . . . .	80 84

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PACKING RECOMMENDATIONS FOR STANDARD EQUIPMENT

INSIDE PACKED PISTON RODS

For Hot or Cold Water, Crude Oil, Gasoline and Light Oils

D-37	D-39	D-42

BOILER GASKETS

Manholes	Handholes	Tube Plates
G-92	G-93	G-95

PUMP VALVES

Service	Pump Valve
Hot Water—High temperatures and pressures	No. 1200
Warm and Cold Water—125 to 300-lb. pressures	No. 1500
Cold Water—75 to 125-lb. pressures	No. 1600
" " " " " "	No. 1700
" " —50 to 75-lb. pressures	No. 1800
Gasoline, Alkali, Lye, Syrups—High pressures	No. 1200
Hot or Cold Oil—High pressures	No. 1200
Cold Oil—75 to 125-lb. pressures	No. 1600
Condenser Service	No. 1900
" "	No. 2000

PACKING RECOMMENDATIONS FOR SPECIAL SERVICE EQUIPMENT

Service	Packing No.
STEEL AND IRON	
Hot Blast Valves and Doors	A-68
Benzol, Tar, Wash Oil	A-72
Converter Bottoms	A-68
Butterfly Valves	A-68
Steam Hammers, Rods and Plungers	C- 1
" " " " "	C- 2
" " " " "	C-13
Steam Hammers and Pistons	D-02
RAILROAD	
Locomotive Cab Cock Mountings	A-24
" Throttles	C-66
" Air Pumps	C-70
" Expansion Joints	A-68
" " "	A-09
Mallet Swing and Ball Joints	A-50
Power Reverse Gears—Cylinders	C-55
" " " —Piston Rods	C-55
" " " —Alco Type	C-54
Feed Water Heater Pistons	D-37
Locomotive Fronts, Dryers, Retorts	G-94
Tank Hose Connections	G-40
" " "	G-50
Brake Valves (Exhaust Pipe Joints)	G-81
OIL FIELD	
Swivels	C- 9
"	A-12
Polish Rod Stuffing Box	C-10
Slush Pumps—Fluid End	C- 6
" " —Steam End	A-01
" " — " "	D-02
OIL REFINERIES	
Percolating Filter Heads	No. 60 Rope
Bubble Towers	A-70
Scraper Rods	A-70
Tank Car—Outlet Caps	G-81
" " —Domes	G-92
" " — "	G-81
LUMBER	
Shotgun feed, Engines, Kickers	A-18 cop. cov.
Niggers, Donkey Engines, Loaders	A-04
Log Turners	C-11

Service	Packing No.
PULP AND PAPER	
Stock Pumps:	
Reciprocating Rods	D-09
" "	F-03 No graphite
" "	D-12
Rotating Rods	A-12 No graphite
" "	A-18 No graphite
Dryer Journal Boxes	A-01
" " "	A-18
Grinder Pistons	D-39
" "	D-37
HYDRAULIC	
Cold Water Accumulators	C- 3
" " "	C- 4
Wheel Presses	C- 5
Plunger Units	C- 6
Plungers with Side Play	C- 7
Elevator Plungers—Inside Packed	D-37
" " —Outside Packed	C- 7
Horizontal Elevator Plungers	C- 8
Clay Pumps	D-09
Deep Well and House Pumps	F-03
" " " " "	F-00
Drinking Water Pumps	F-03 Waxed, no gr.
Salt Water Pumps	F-00 Waxed, no gr.
Sandy Water Triplex Pumps	D-09
" " " "	D-12
MARINE	
Bilge Pumps:	
Auxiliary to Main Engine	F-03 Soft.
Independent—Steam Rods	A-01
" —Fluid Ends	C- 6
" —Stern Gland	F-00
Diesel Engine Oil Pumps	C-14
Crude Oil Pumps	D-09
DAIRIES	
Homogenizers and Viscolizers	C-12
Pasteurizers	F-03 Dry.
Sterilizers	D-02 Dry.
"	D-37
ARTIFICIAL GAS	
Exhauster Shafts	A-18
Generator Ash and Clinker Doors	A-68
Hot Valves (Generator to Carburetor)	A-18
Purifier Box Covers and Door Seals	A-18

Rod Packing, Style No. A-01

HIGH PRESSURE ASBESTOS ROD PACKINGS

Frictioned non-metallic asbestos cloth is the basic material in this type of packing. Laminations of this asbestos cloth are formed into a thick strip which is then wrapped with several layers of the same material. Some styles contain a rubber core or back. The packings are formed into a square or round cross section, treated with a heat-resistant lubricating compound and then graphited. Unless otherwise noted, square cross-section will be furnished. All styles are available in Spiral, Coil, and Ring forms—in sizes $\frac{1}{4}$" and up.

HIGH PRESSURE ASBESTOS ROD PACKINGS

Style No.	Description
A-01	Rectangular red rubber back in all sizes $\frac{3}{8}$" or larger.
A-02	Square section, without rubber back or core.
A-03	Round section, without rubber back or core.
A-04	Square section, with round rubber core.
A-05	Round section, with round rubber core.

ASBESTOS BRAIDED ROD PACKINGS

In the manufacture of these packings, asbestos yarn in which each strand has been thoroughly lubricated and graphited, is used. Commercial grade yarns will be furnished unless otherwise noted, but other grades are available. Two types of construction are used, namely, the braid-over-braid process and the flax-type braid process (plaiting). Furnished in square cross-section unless otherwise noted.

All styles of these asbestos braided rod packings are available in Coil, Spiral and Ring forms and also in reels—in sizes $\frac{1}{4}$" and up with the exception noted.

ASBESTOS BRAIDED ROD PACKINGS

Style No.	Description
A-09	Plaited, metallic yarn, lubricated for steam, air, gas and ammonia service on centrifugal pumps.
A-12	Plaited, non-metallic yarn, lubricated for steam, air, gas, ammonia service on centrifugal pumps.
A-15	Braid-over-braid, metallic yarn, lubricated principally for air service on reciprocating rods. (For round cross-section, specify A-16.)
A-18	Braid-over-braid, non-metallic yarn, lubricated for steam, air, gas, ammonia service on reciprocating rods. (For round cross-section, specify A-25.)
A-28	Braid-over-braid, non-metallic yarn, lubricated for gasoline service on reciprocating rods and valve stems. (For round cross-section, specify A-72.)
A-30	Plaited, non-metallic yarn, lubricated for gasoline service on centrifugal pumps. Sizes $\frac{1}{8}$" and up.
A-56	Braid-over-braid, non-metallic 100% pure blue asbestos yarn, lubricated for caustic service on reciprocating rods.
A-58	Plaited, non-metallic 100% pure blue asbestos yarn, lubricated for caustic service on rotary rods.
A-65	Braid-over-braid, non-metallic 100% pure blue asbestos yarn, lubricated for acid service on reciprocating rods.
A-67	Plaited, non-metallic 100% pure blue asbestos yarn, lubricated for acid service on rotary rods.

A Braid-over-Braid Rod Packing

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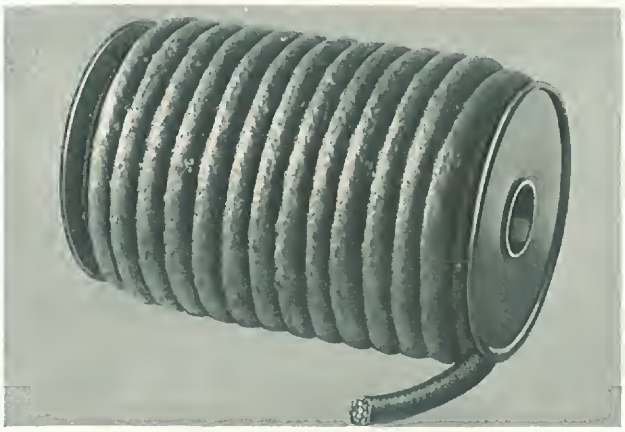
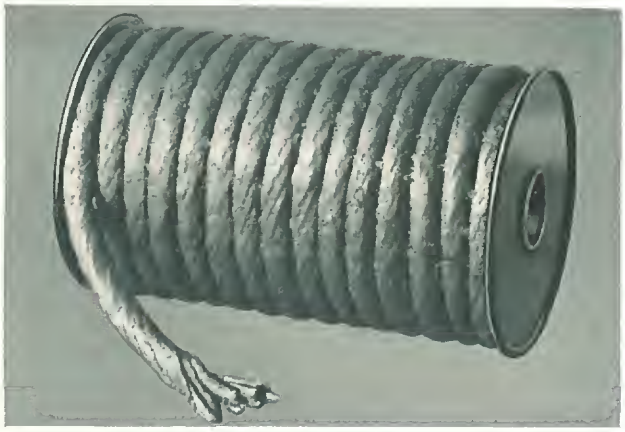


Braided Valve Stem Packing, Style No. A-25



Twisted Valve Stem Packing, Style No. A-26

ASBESTOS VALVE STEM PACKINGS

These packings are manufactured by two processes as noted with individual items. Braided packings are made by the braid-over-braid process, and twisted packings are formed by twisting the strands of asbestos yarn. Twisted packings are lubricated and graphited throughout unless otherwise noted. All yarns used are non-metallic and normally furnished in Commercial grade asbestos. Unless otherwise specified, the round cross-section will be furnished.

All styles are available on $\frac{1}{4}$, $\frac{1}{2}$, 1 and 5-lb. spools and on reels—in sizes as noted.

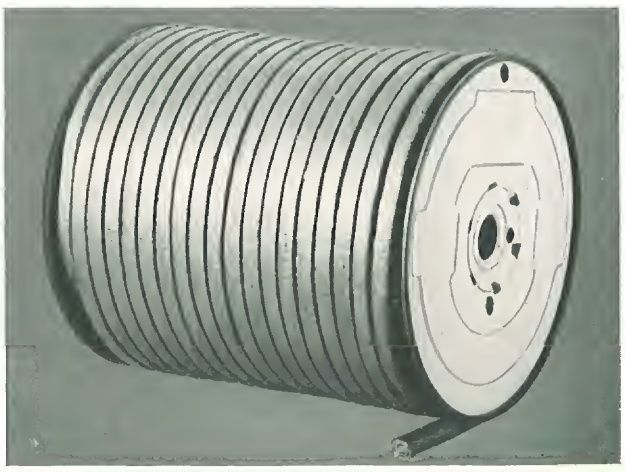
ASBESTOS VALVE STEM PACKINGS

Style No.	Description
A-24	Braided, pure asbestos yarn, surface ***only*** is graphited. For superheated steam service. Sizes $\frac{1}{8}$" and up. (For square cross-section, specify A-23.)
A-25	Braided, for general (steam, air, gas and ammonia) service. Sizes $\frac{1}{8}$" and up. (For square cross-section, specify A-18.)
A-26	Twisted, for general (steam, air, gas and ammonia) service. Sizes $\frac{1}{16}$" and up.
A-47	Twisted, 100% pure blue asbestos yarn, for acid service. Sizes $\frac{1}{8}$" and up.
A-72	Braided, for gasoline service. Sizes $\frac{1}{8}$" and up.
A-77	Twisted, for gasoline service. Sizes $\frac{1}{16}$" and up.
A-90	Braided, pure asbestos yarn, for high temperatures. Sizes $\frac{1}{8}$" and up.
A-95	Twisted, pure asbestos yarn, for high temperatures. Sizes $\frac{1}{16}$" and up.

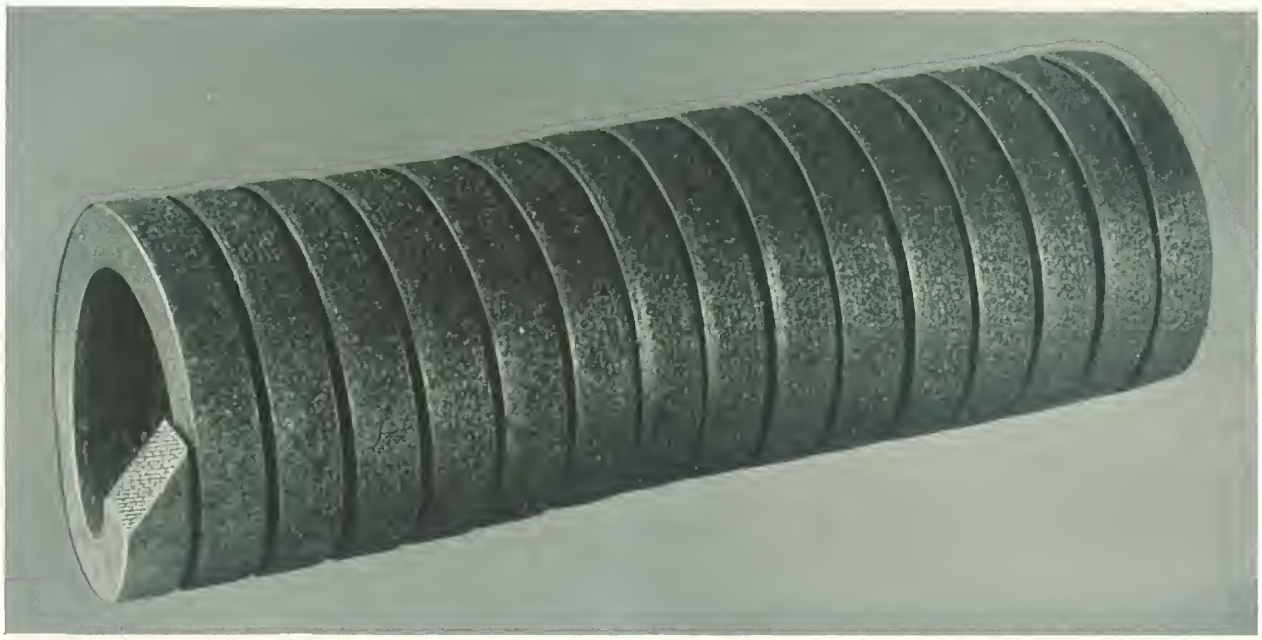
NOTE: Packings A-12, A-56, A-65 and A-70, as described under Asbestos Braided Rod Packings, are also used on valve stems for the services listed. Packing A-68, as described under Special Asbestos Packings, is also used for valve stems as noted.

SPECIAL ASBESTOS PACKINGS

Style No.	Description
A-68	A braided packing which is recommended for high temperature conditions. The asbestos yarn contains Monel Wire insertions and each strand of yarn is treated with a special heat-resistant compound. It may be used as a valve stem packing and is ideal for expansion joints and as groove packing on doors, butterfly valves, etc. It is furnished with square cross-section on spools—for sizes $\frac{1}{8}$" to $\frac{1}{4}$"—in Coil form—for sizes $\frac{3}{8}$" and up—and also in Ring form.
A-10	A special packing designed for air compressor service. Consists of a square braided flax center over which is wrapped several layers of asbestos cloth. Lubricated, graphited, with square cross-section, it is furnished in Coil, Spiral and Ring forms—in sizes $\frac{3}{8}$" and up.
A-50	Designed especially for Mallet type locomotive, ball and swing joint use. It is similar in construction to A-09 (asbestos braided packing) and is formed by braiding yarn which contains a very high asbestos fibre content. The inner part of the packing is dry, the surface ***only*** being treated and graphited. It is furnished with a square cross-section in Coil and Ring forms and also on reels, in sizes $\frac{1}{4}$" and up.



Style No. A-68 for high temperature service



Low Pressure Steam and Ammonia Packing, Style No. D-09

DUCK-AND-RUBBER PACKINGS

These packings are formed by laminations of high grade duck laid up with rubber compound.

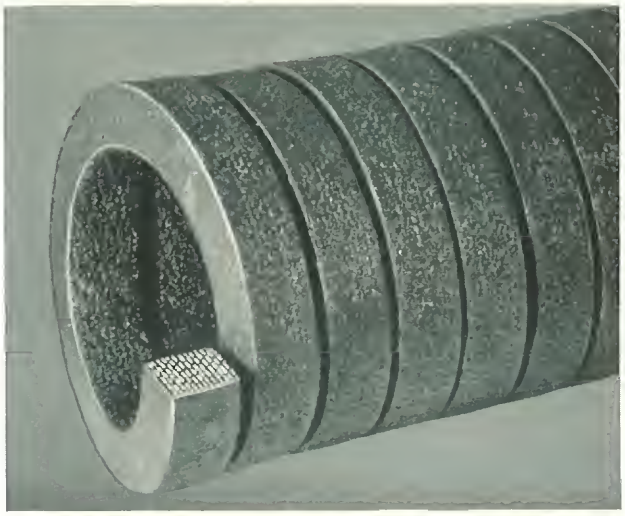
Group 1

For low pressure steam, ammonia and hydraulic service on reciprocating rods. Furnished lubricated and graphited in square cross-section unless noted, in Coil, Spiral and Ring forms—sizes ¼" and up.

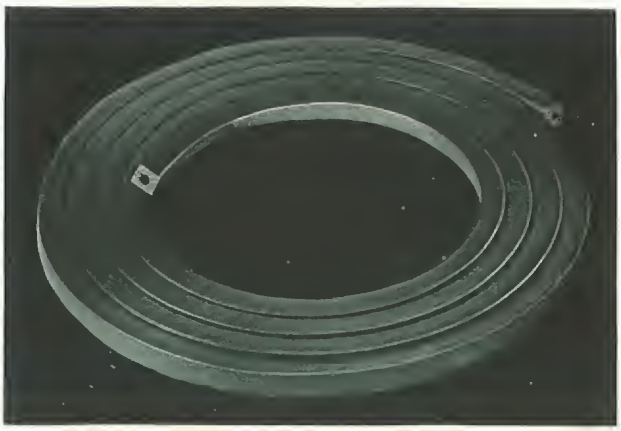
DUCK-AND-RUBBER PACKINGS	
Style No.	Description
D-02	Horizontal laminations, particularly recommended for low pressure steam service.
D-06	Laminations wound around a round red rubber core. Ideal for hot water service. Furnished in round cross-section.
D-09	Diagonal laminations, particularly recommended for low pressure, steam and ammonia service.
D-12	Laminations wound around a hollow center. May be used for all services mentioned above.
D-56	Horizontal laminations, specially treated for ammonia service.

Group 2

Recommended for *inside* packed pistons. Formed by horizontal laminations of fine duck laid up with either white or black rubber compound which tends to minimize swelling in hot or cold water services. Furnished with square cross-section, Regular cure, unless Rock-hard cure is requested. Can be furnished stitched where specified. Avail-



Duck-and-Rubber Rod Packing, Style No. D-02



Style D-12, a Hollow Center Packing

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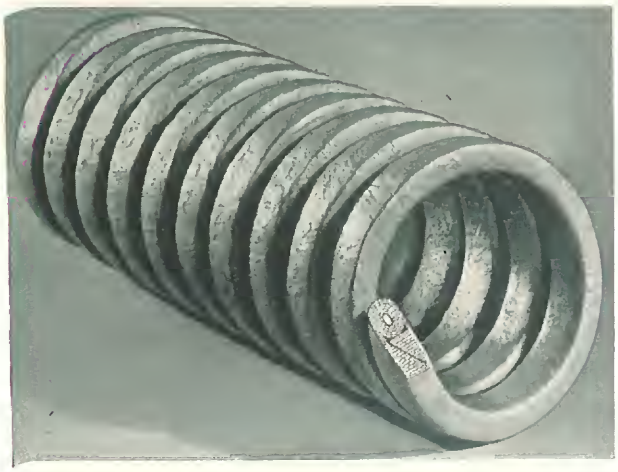
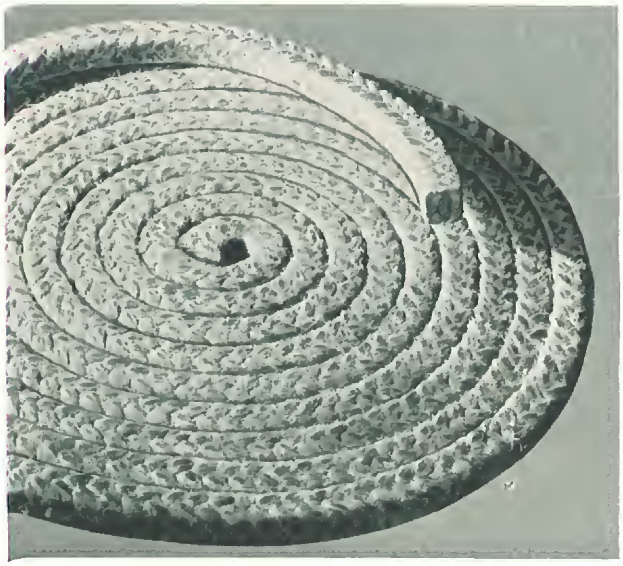
Duck-and-Rubber Packing, Style No. D-37



Diagonal Wedge Duck-and-Rubber Packing



Flax Packing, Style No. F-00

able in Coils, Solid Rings and Mortice Joint Rings—in sizes ¼" and up.

DUCK-AND-RUBBER PACKINGS	
Style No.	Description
D-37	White friction hydraulic.
D-39	Black friction hydraulic.

Group 3

Diagonal wedge packings are recommended for reciprocating rods which are worn or out of alignment. Made in two parts—consisting of a cushion which varies as noted below, and wedges of diagonally cut duck-and-rubber. Both parts are thoroughly lubricated, graphited and then held together in a braided cotton jacket to form an integral unit to facilitate installation. Furnished in Coil, Spiral and Ring form in sizes ¼" and up.

DUCK-AND-RUBBER PACKINGS	
Style No.	Description
D-17	Cushion consists of Style D-06 duck-and-rubber packing. For L. P. steam and ammonia service.
D-20	Cushion consists of a solid braided flax packing. For L. P. steam—hot or cold service.
A-92	Cushion consists of Style A-04 asbestos high pressure packing. For high pressure steam service.

FLAX AND JUTE PACKINGS

These braided flax and jute packings vary only in length of fibre and lubrication treatment. They are intended principally for hydraulic service on reciprocating or rotary rods. Available in Coils, Rings and Reels as well as spiral form—in sizes noted.

FLAX PACKINGS				
Style No.	Grade of Roving	Treatment	Regularly Furnished	Sizes
F-00	Long line flax	Pure tallow	Ungraphited	⅛" and up
F-03	Long line flax	WPH pure Japan wax	Graphited	¼" and up
F-07	Tow flax	Pure tallow	Ungraphited	⅛" and up
F-15	No. 1 jute	Pure tallow	Ungraphited	⅛" and up
F-17	Tow flax	WPH pure Japan wax	Graphited	¼" and up
F-29	No. 1 jute	WPH pure Japan wax	Graphited	¼" and up
F-60	Channel Type Flax consists of Style F-03 WPH square flax packing which is encased on three sides with a duck-and-rubber casing. For use only on reciprocating rods and elevator plungers. Furnished in Coil, Spiral and Ring forms—in sizes ¼" and up.			

P. K. Rings, showing self sealing construction

P. K. SELF SEALING RINGS

Die pressed molded-lip packing, furnished in rings which nest together to form sets; the number of rings in the set depends on the size of the stuffing box. This construction forms a set that automatically expands and contracts with pressure, thereby providing an absolute seal.

Sets are furnished with bottom rings beveled or squared to fit the stuffing box. The diameter of rod and inside diameter and depth of stuffing box should be specified. Also information should be provided whether neck or glands and bottom of stuffing box are flat or beveled. If beveled, angle should be specified.

The following styles of P.K. Self Sealing Rings have been designed for specific services:—

P. K. SELF SEALING RINGS

Style No.	Service	Description
P. K. 068	Hydraulic	Made from a duck-and-rubber combination.
P. K. 078	High Temperature Steam	Made from Asbestos Cloth bonded and felted together.
P. K. 168	Cold Oil	Made from Woven Duck bonded with Neoprene.
P. K. 178	Hot Oil	Made from Asbestos Cloth bonded with Neoprene.
P. K. 568	Hot Water	Made from high quality duck-and-rubber.

METALUBE ROD PACKINGS

Valley Forge Metalube Packing is specially designed for long, trouble-free life on severe services. Hot or cold acids, caustics, tar, asphalt and ammonia as well as steam and water can be held with Metalube when other packings might be expected to quickly fail.

The construction of Metalube consists of a high-melting-point lead alloy channel that contains a core of lubricated fibrous material that is best suited to the particular service. The outer surface of the channel is pierced with diagonal slots that permit passage of external lubrication into the fibrous core.

The lead alloy channel has excellent strength and non-friction characteristics and the core provides resiliency and acts as an oil reservoir between service lubrications.

Metalube packing is available for the following services in a full range of sizes. Available in Spirals and Rings.

SEMI-METALLIC ROD PACKING

Metalube Style	Service	Core Material
No. 1000	Steam	A-01
No. 1001	Water	A-12
No. 1002	Oil	A-70
No. 1003	Acids	A-65
No. 1004	Ammonia	D-56
No. 1005	Caustics	A-56
No. 1006	Tar and Asphalt	Asbestos and lead wire braided

Metalube Rod Packing

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COMBINATION PACKING SETS

These sets are furnished in Ring form and consist of various styles of packings which are assembled into Ring Sets for specific uses as noted in the Packing Recommendation tables.

COMBINATION PACKING SETS

Combination (Style No.)	End Rings (Style No.)	Intermediate Rings (Style No.)
C-1	M-26	A-04
C-2	M-26	D-17
C-3	M-26	F-03 and D-12
C-4	M-26	F-03 and D-09
C-5	M-26	F-03 and D-39
C-6	D-09 and D-12, Alternating	
C-7	F-00 and D-12, Alternating	
C-8	D-37	D-09 and D-12
C-9	A-01 and A-18, Alternating	
C-10	Special Soft Rubber Rings	
C-11	M-26	D-09
C-12	D-37	F-03 (Waxed, no graphite)
C-13	A-12 (Rubberized) and Lead Separator Rings Alternating	
C-14	D-09 and F-03, Alternating	
C-54	D-02	D-02 (diagonal cut)
C-55	A-02	A-18
C-66	A-04	A-04
C-70	Air End A-02, Steam End A-04	
M-26	This is not a combination set in itself but is used as End Rings in some of the sets mentioned above. It is a braided soft copper wire packing designed principally for heavy hydraulic service. It is also available in Spiral form and on Reels—in sizes $\frac{3}{16}$" and up, for those who wish to cut their own Rings.	

ASBESTOS ROPE AND WICK PACKINGS

These packings are made by twisting or braiding non-metallic asbestos rovings or yarns to the required sizes. They are furnished unlubricated and ungraphited, in Commercial grade asbestos unless otherwise specified.

ASBESTOS ROPE AND WICK PACKINGS

Style No.	Description
45	Asbestos wick—twisted. Approximately $\frac{1}{4}$" diameter, in $\frac{1}{4}$, $\frac{1}{2}$, 1-lb. balls and also on reels. Commercial grade asbestos furnished unless otherwise specified.
50	Asbestos rope—twisted. $\frac{3}{8}$" to 2" diameter, in 25 or 50-lb. reels.
60	Asbestos rope—braided. Solid braided, round or square, in coils or reels, $\frac{1}{4}$" and up.
61	Asbestos rope—braided. Single braid over twisted core, in coils or reels, round or square, $\frac{1}{4}$" and up.
62	Asbestos rope—braided. Double braid over twisted core, in coils or reels, round or square, $\frac{1}{4}$" and up.

PLASTIC PACKINGS

All Plastic Packings are furnished in loose form or in round or square coils. These packings have an asbestos fibre base, some are furnished with metal, some without, according to the service.

Plastic packings should be used with top and bottom rings of fabric packing which should be chosen from the Recommendation Chart for the service required.

PLASTIC PACKINGS

Style No.	Service	Color	Description
1	General—Up to 600° F.	Black	Combination of shredded lead and asbestos fibre.
2	High Temperature Service above 600° F.	Black	Shredded Copper and Asbestos.
3	Distillates, Solvents and Edible Oils.	White	Shredded Lead and Asbestos Fibre with special lubrication.
4	Acids and Chemicals.	Black	Contains no metal.
5	For Food Products	White	Contains no metal.

PUMP VALVES

The pump valves listed below will answer practically all service requirements. In ordering be sure to specify dimensions as well as style number.

PUMP VALVES

No.	Description
1200	A very hard—black rubber valve, for high temperature and high pressure duty in service against Hot Water, Hot Oils, Gasoline, Alkali, Lye, Syrups and other solutions up to 212° F. at any pressure.
1500	A hard—black rubber valve, for warm or cold water service at pressures from 125 to 300 lbs. per sq. in. An excellent valve for Mining Pumps and other heavy duty equipment.
1600	A medium hard—black rubber valve, for cold water or cold oil service at pressures from 75 to 125 lbs. per sq. in. A tough, serviceable valve, especially efficient for gritty water.
1700	A medium hard—gray rubber valve, for cold water service at pressures from 75 to 125 lbs. per sq. in. An all-around Hydraulic Valve, very serviceable on City Pumping Station Equipment and Hydrant Valves.
1800	A medium soft—gray rubber valve, for general cold water service at pressures from 50 to 75 lbs. per sq. in.
1900	A very soft—red rubber valve, for Air and Marine (lake and ocean) Condenser Service.
2000	A very soft—gray rubber valve, for Air and Marine Condenser Service.

EHRET
INSULATIONS

SHEET PACKINGS

The Ehret Valley Forge sheet packings listed and described in the table below will satisfy all normal requirements for this type of packing material.

Special sheet packings will be made on order for those who desire them. They can be made to comply with any given specification.

Style No.	Service	Description	Form	Size	Thickness
ASBESTOS COMPRESSED SHEET PACKINGS					
S-80	Superheated Steam....	Cross Laminated, Natural Gray Color.....	Sheets	50″ x 50″ and 50″ x 150″ all 3 styles	$\frac{1}{32}$″ and up all 3 styles
S-81	High Pressure Steam..	Cross Laminated, Natural Gray Color or Black on One Side, Graphited Other Side.....	Sheets		
S-82	Hot Oil.....	Homogeneous Construction, Natural Gray Color.....	Sheets		
ASBESTOS METALLIC SHEET PACKINGS					
S-83	Steam, Air and Water..	Frictioned Asbestos Cloth with Woven Wire Insertion. Plain White or Graphited, One or Both Sides.....	Full and Cut Rolls	40″ wide	$\frac{1}{32}$″ and up
S-84	Combustion Engine....	Same Material, but Red Compound One Side, Other Side Graphited.....		40″ wide	$\frac{1}{32}$″ and up
VEGETABLE FIBRE SHEET PACKING					
S-53	Gasoline, Naphtha, Benzine, Kerosene..	Brown Compressed Fibre.....	Sheets	41″ x 41″	$\frac{1}{64}$″ and up
RUBBER SHEET PACKINGS					
S-405	Hydraulic.....	Red Rubber—Best Grade.....	Full and Cut Rolls	36″ width all 5 styles	$\frac{1}{32}$″ and up
S-40	Hydraulic.....	Red Rubber—Commercial.....			$\frac{1}{32}$″ and up
S-41	Hydraulic.....	Red Rubber—Brass Wire-Inserted.....			$\frac{1}{16}$″ and up
S-45	Cold Oil.....	Black Oilproof Rubber.....			$\frac{1}{32}$″ and up
S-48	Hydraulic.....	Pure Gum (Gray).....			$\frac{1}{16}$″ and up
RUBBER SHEET WITH DUCK INSERTIONS					
S-46	Hydraulic.....	Diaphragm.....	Full and Cut Rolls	36″ width all 4 styles	$\frac{1}{16}$″ and up all 4 styles
S-50	Cold Water.....	Gray Rubber—Cloth Inserted.....			
S-51	Cold Water.....	Gray Rubber—Cloth Insertions on One Side.....			
S-52	Cold Water.....	Gray Rubber—Cloth Insertions on Both Sides.....			

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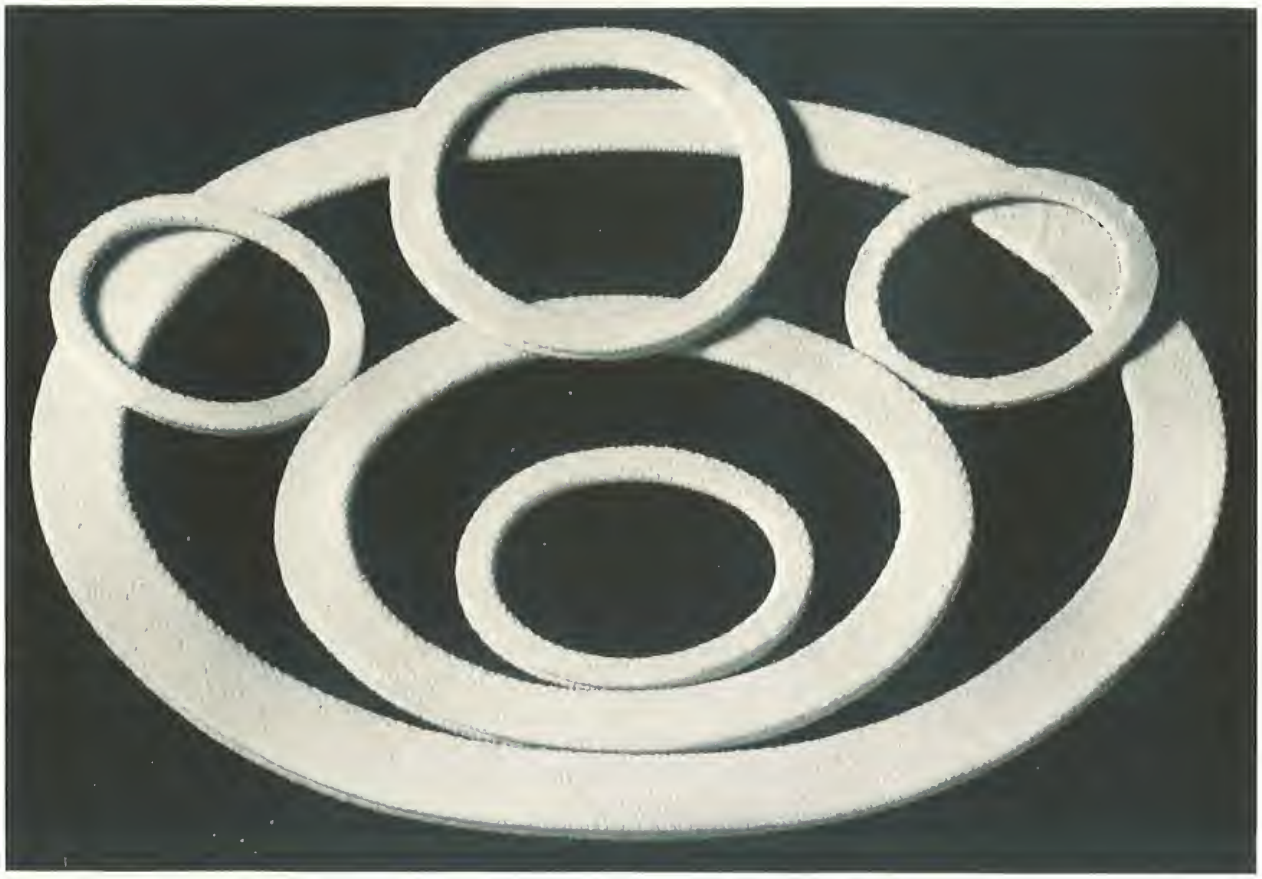
EHRET
INSULATIONS



Commonly used sizes of Folded Manhole and Handhole Gaskets

GASKETS AND JOINTINGS

Cut Gaskets

Orders for cut gaskets should be accompanied by desired dimensions, shapes, thicknesses, etc. When available, templates or samples should also be furnished. All Ehret Sheet Packings are available in cut gasket forms. In addition to furnishing the required dimensions, the desired sheet packing material should be specified by style number.

Typical Cut Gaskets for Flanges

Folded Gaskets

The following types of folded gaskets are available in a complete range of sizes and shapes. Required dimensions should accompany all orders.

FOLDED GASKETS	
Style No.	Description
G-92	Manhole—high pressure wire-inserted asbestos boiler gaskets that are folded and jointed.
G-93	Handhole—similar to G-92.
G-95	Manhole or Handhole—similar to G-92 and G-93 except the construction is seamless instead of jointed.

Gasketing Materials

Style No.	Description
G-94	Wire-inserted asbestos gasket tape in widths of $\frac{1}{2}''$ and up—thicknesses of $\frac{1}{16}''$ and up.
G-96	Wire-inserted asbestos gasket tubing in diameters of $\frac{3}{8}''$ and up.
G-97	Red rubber gasket tubing in diameters of $\frac{1}{4}''$ and up.

EHRET

BUILDING

INSULATIONS and MATERIALS

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. BI 575

Printed in U. S. A.

Snow on the roof of a well-insulated house gives evidence of fuel savings. The same insulation keeps the house cool in summer by reducing the penetration of solar heat.

. . . For All-Year-Round Economy and Comfort Install . . .

EHRET'S HEAT-SEAL INSULATING WOOL

Typical Example of Savings . . .

For illustrative purposes, consider a typical seven-room house of the following description. The savings effected by insulating the walls and roof with 4 inches of Ehret's Heat-Seal Insulating Wool are indications of the economy made possible by the proper use of home insulation.

Area of outside walls is 1137 square feet.

Area of roof is 962 square feet.

Wall construction is frame with interior studs, lath and plaster, sheathed, building paper and wood shingles.

Roof construction is composition shingles over solid sheathing.

Heating plant efficiency is 50%.

Heating plant operates 24 hours a day for approximately 200 days a year.

Average difference between inside and outside temperatures is 40° F.

Under the above conditions the anthracite coal required to heat the un-insulated house amounts to approximately 10 tons per season. At $10.50 per ton, this fuel cost is $105.00. When the house is insulated with Ehret's Heat-Seal Wool at a cost of approximately $285.00, the coal consumed drops to 6 tons, and an annual cash saving of $42.00 results.

For oil firing of the same plant, at a fuel cost of 6 cents per gallon, savings per season will amount to over $57.80.

In addition to the cash savings in fuel, the use of Ehret's Heat-Seal Insulating Wool results in many other benefits and advantages, as described on the reverse of this sheet.

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EHRET
INSULATIONS

WHY IT PAYS TO INSULATE . . .

The use of Ehret's Heat-Seal Insulating Wool in the walls, partitions, ceilings and roofs of buildings has, for many reasons, grown rapidly in recent years. When installed in either old or new construction, this material does much to increase the comfort and protect the health of the occupants, reduce the cost of heating or air-conditioning and greatly improve rental and sales values.

Some of the detailed advantages to be gained by insulating residential as well as business properties are listed below.

Temperature control—is more uniform throughout the building both from hour-to-hour as well as from season-to-season.

Warm floors—result from the uniformity of temperature control. Colds and sickness, especially among children, are held to a minimum because of the lack of circulatory drafts.

Less work—is required in tending manually fired heating plants in insulated structures; fewer firings, less fuel and ashes to be handled.

Fuel savings—attributable to building insulations range, in many cases, as high as 40%. The savings in fuel will generally pay for the cost of insulating in a few years.

Smaller heating plant—can be used in new construction when the home is to be insulated, because of the absence of unnecessary heat losses. Fewer radiators, smaller pipes and smaller hot air ducts can be installed with a substantial saving that can well be applied on the initial cost of the insulation.

Heat is retained—during periods at which the heating plant is operating below normal requirements. This factor prevents excessive chilling of the house during cold nights.

Summer heat—is minimized within the insulated home. Radiated heat from the sun rarely penetrates the well-insulated roof. Top floor rooms are cooler, which permits restful sleep. Summer temperatures in insulated homes are often 10° lower than in homes that are not protected.

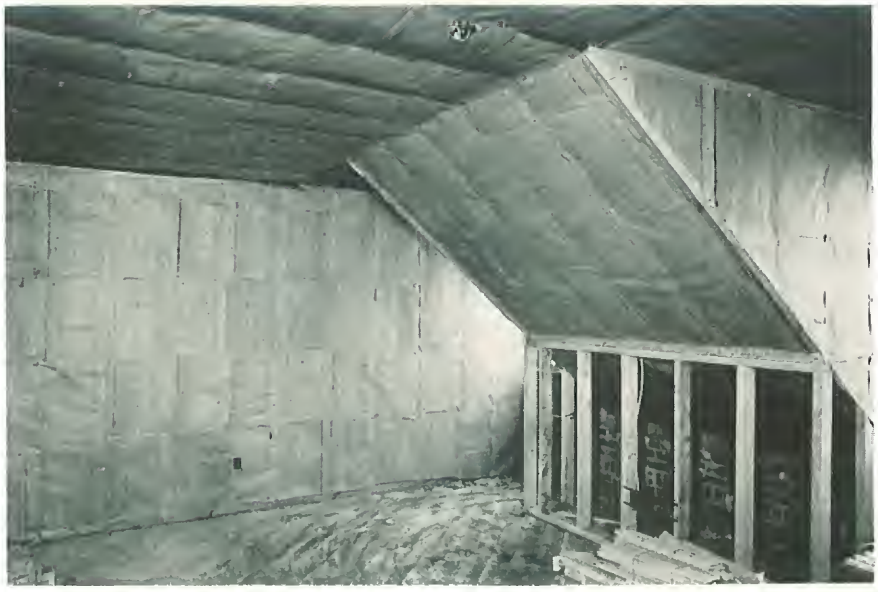
Cooling and air-conditioning—when installed in insulated residences or buildings, can be operated with less power, trouble or expense.

Fire risk reduced—in dwellings having the walls filled with Ehret's Heat-Seal Insulating Wool. Being non-combustible, the chances of electrical short-circuit and other types of wall fires are greatly reduced by the fireproof character of the insulation within the structure.

Noise reduction—results from proper insulation. The sound absorbent characteristics of Ehret's Heat-Seal Wool insulations are great. Hollow partitions, even if thin and light, will act as sound barriers when filled with this material.

Re-decoration costs reduced—by home insulations. In un-insulated homes the seepage of air through the walls and plaster filter dirt, dust and grease into the pores of the wall surfaces. Insulation reduces air seepage to a minimum and consequently walls stay clean much longer. Reduction of circulatory drafts within the home also retards the formation of dirt streaks on walls and ceilings.

Property values are increased—in those homes that are properly insulated. Tenants and prospective buyers are willing to pay for the advantages of insulated comfort.



Ehret's Heat-Seal Insulating Wool in the form of paper-backed Batts, has been applied to the studs and joists of this attic space. Even though no wall finish is to be applied over the insulation, this house will stay warm in winter and cool in summer.

Paper-backed Batts of Ehret's Heat-Seal Insulating Wool are readily applied with tacks or staples. The backing forms a tight vapor barrier that prevents the penetration of moisture.

EHRET'S HEAT-SEAL INSULATING WOOL

The raw material used in the manufacture of Ehret's Heat-Seal Insulating Wool is a carefully proportioned mixture of various types of rock. By melting at high temperatures and blowing the molten rock with jets of high pressure steam, it is transformed into a fine, light, fibrous form which closely resembles wool in general appearance.

The chemical composition of its ingredients and the processes used in the manufacture of Ehret's Heat-Seal Insulating Wool result in a product that is exceptionally well suited for use as a building insulation. It is moisture resistant, flexible, odorless and chemically inert. The strength of individual fibres is high as is also their elasticity. Consequently, there is practically no tendency to settle, pack or disintegrate in service.

The insulating value of Ehret's Heat-Seal Insulating Wool is high. When properly packed into ceilings, walls and partitions, its close, tight, blanket-like character practically eliminates air movements within the structure.

Ehret's Heat-Seal Insulating Wool is made in three forms; namely, Granular, Loose and Batts. The material in all three forms is approximately the same in insulation efficiency. The various forms are used in different types of building construction, usually depending upon application limitations and requirements.

GRANULAR WOOL

Ehret's Heat-Seal Insulating Wool in Granular form consists of small pellet-shaped particles which can be poured, spread or blown into place. This form is frequently used in un-floored attics to cover the ceilings of the rooms below. With blowing equipment, this Granular material can be used to fill walls, partitions and other spaces in old construction that are inaccessible for the installation of either Loose Wool or Batts.

Granular wool being poured between joists in an unfinished attic

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EHRET
INSULATIONS

LOOSE WOOL

Loose wool is used for hand packing, generally in new construction, in places such as walls, partitions, over-hangs, fire stops, the ends of knee walls and other places where it is advantageous to fill or block off a section with insulating material.

WOOL BATTS

Widely used in new construction, Batts are the most satisfactory form of wool insulation from many standpoints. In manufacturing Ehret's Heat-Seal Insulating Wool Batts, they are felted with a binding material which does not in any way affect the insulating value, but insures uniform density and long life. These Batts are available in two thicknesses, namely, Wall Thick and 2". The Wall Thickness is approximately 4" which is sufficient to snugly fill walls or partitions having 4" studding. Batts are available both with and without attached paper backing, as well as treated and untreated, as noted in the table below. Where paper backed Batts can be applied, their use is recommended because the backing acts as a vapor seal or barrier and also facilitates application. It extends beyond the sides of the Batt, and the overhang can be tacked or stapled directly onto the face or sides of studs and joists.

The moistureproof characteristics of the backing on Batts prevents the absorption or passage of water into the insulation itself. Freshly plastered areas are likely to transmit water into the insulation if un-backed Batts are used. In attics and similar unfinished areas where the walls are not to be covered with plaster or wallboard, the paper is of sufficient strength to hold the Batt in place when properly stapled on.

Packaging

Ehret's Heat-Seal Insulating Wool is available in the following standard forms and containers:

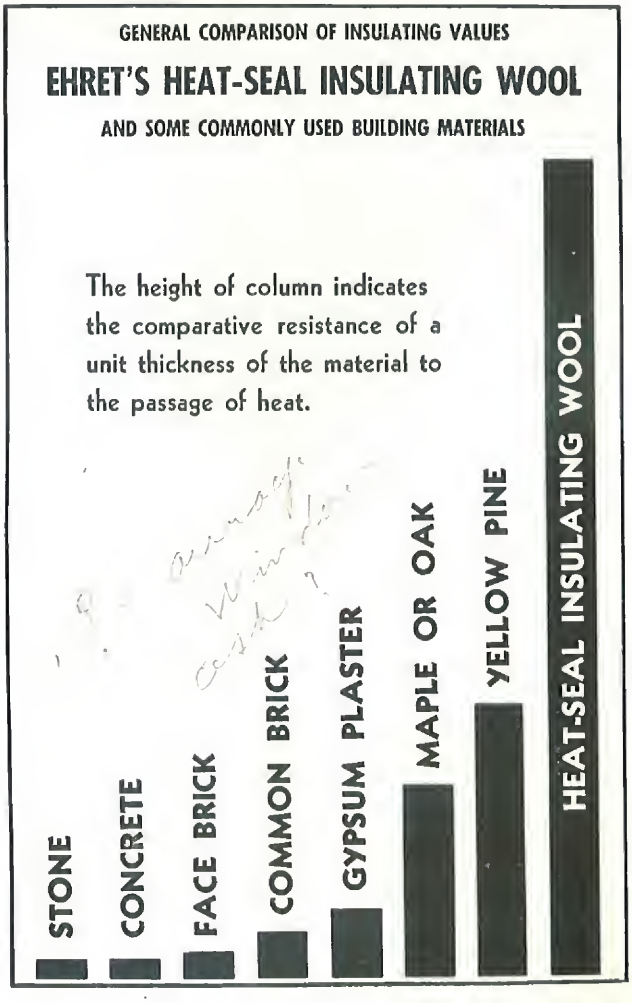
Product	Paper Bags, Net Weight	Coverage Per Bag
Loose Wool	35 lbs.	17 sq. ft., 4" Thk.
Granulated Wool	35 lbs.	16-18 sq. ft., 4" Thk

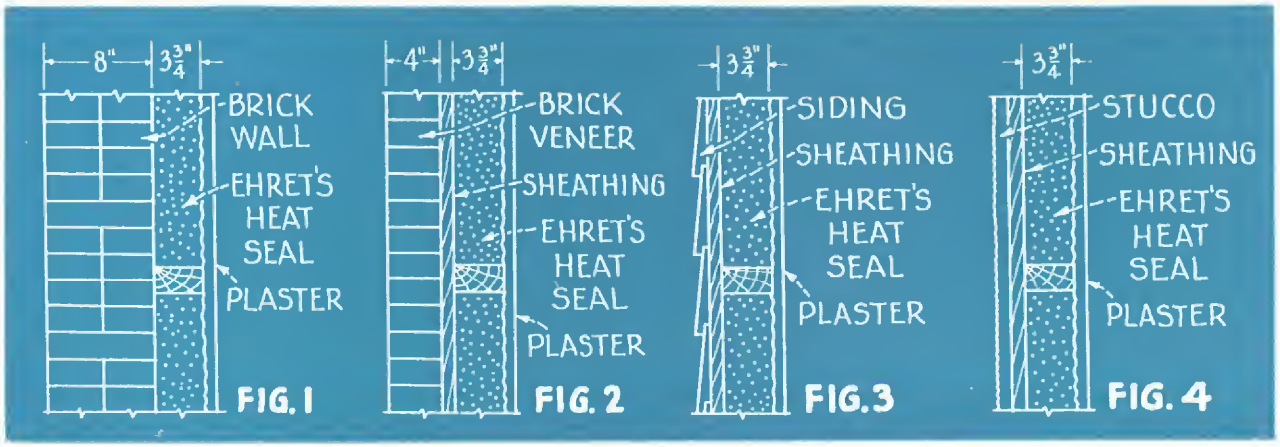
BATTS

Thickness of Batt	Number of Batts Per Carton	Size of Batt	Area Per Batt	Net Area of Insulation Per Carton
* Wall Thick..	8	15" x 23"	2.4 sq. ft.	19.2 sq. ft.
* Wall Thick..	4	15" x 48"	5.0 sq. ft.	20.0 sq. ft.
† Wall Thick..	16	12" x 15"	1.25 sq. ft.	20.0 sq. ft.
* 2".....	12	15" x 23"	2.4 sq. ft.	28.8 sq. ft.
* 2".....	6	15" x 48"	5.0 sq. ft.	30.0 sq. ft.
§ 2" (Strips)..	2 (in Bag)	15" x 108"	11.25 sq. ft.	22.5 sq. ft.

* Treated Wool with attached paper backing, also without backing, if specified.
† Treated Wool without paper backing. Untreated Wool also available.
§ Treated or untreated Wool, with or without paper backing, as specified.

The loose wool shown here has been packed between studs, from the top down. It stands without settling or dropping even when applied in this manner.





INSULATING WOOL IN TYPICAL BUILDING CONSTRUCTION

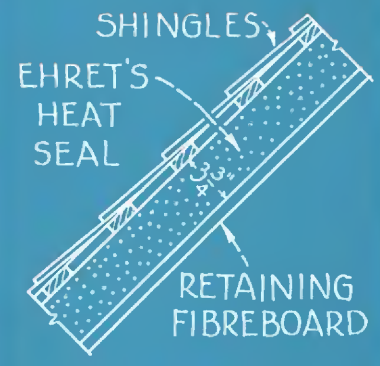


FIG. 5

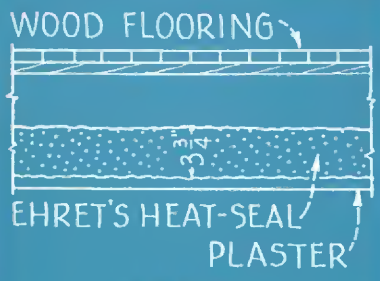


FIG. 6

FIG. 7

Table below shows unit heat losses through un-insulated structures as well as losses and savings through the insulated structures under the same external conditions.

Fig. No.	Description	Loss Without Insulation	With Insulation		
			Loss	Saving	% Saving
1	Brick Wall.....	.350	.063	.287	82
2	Brick Veneer on Wood Sheathing.....	.270	.062	.208	77
3	Wood Siding and Wood Sheathing...	.260	.060	.200	77
4	Stucco over Wood Sheathing.....	.300	.064	.236	79
5	Wood Shingle Roof...	.460	.060	.400	87
5	(Composition Shingle)	.550	.065	.485	88
5	(Slate Shingle).....	.435	.064	.371	86
6	Wood Floor over Ceiling.....	.250	.060	.190	76
7	Wood Floor over Unheated space.....	.340	.060	.280	82
8	Open Attic Floor over Ceiling.....	.690	.070	.620	88
9	Concrete Floor over Suspended Ceiling .	.330	.060	.270	81

(Losses given in BTUs per square foot of exposed surface, per hour, per degree F. of temperature difference.)

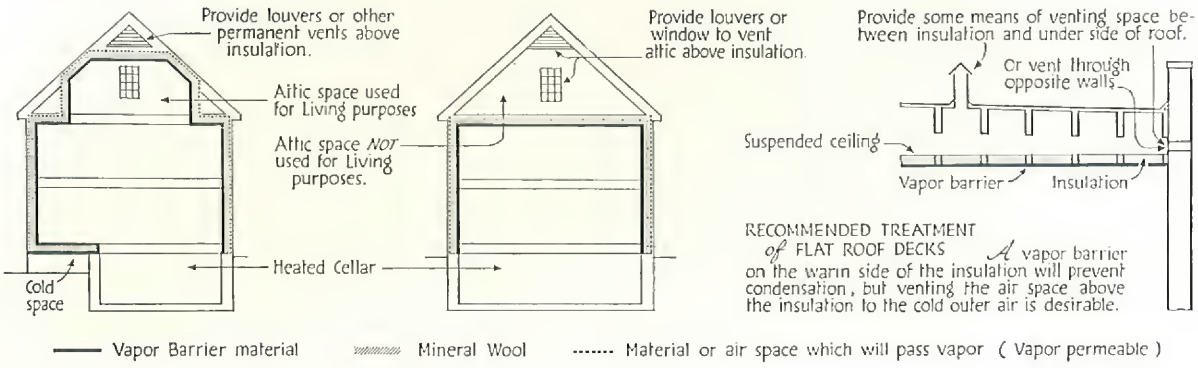
FIG. 8

FIG. 9

EHRET
INSULATIONS

WHERE TO USE EHRET'S HEAT-SEAL INSULATING WOOL IN BUILDINGS

With Proper Relationship of Vapor Barriers and Vapor Vents



METHODS OF APPLYING . . .

There are two general methods in common use for applying wool-type building insulations. They are generally referred to as the Hand-Pack method and the Blowing method.

The application method to be used depends mainly upon the accessibility of the spaces to be filled. The Hand-Pack method is ordinarily used wherever the materials can be so installed.

All three forms of Ehret's Heat-Seal Wool, namely, batts, loose and granular, can be installed by the Hand-Pack method. For Blowing, however, only the granular form of material can be used.

Application recommendations for the Hand-Pack method of applying Ehret's Heat-Seal Insulating Wool are presented on this and the following data sheet. These application suggestions are based on recommendations made by the National Mineral Wool Association.

Full-thickness (4") Heat-Seal Wool insulation is recommended for all climatic conditions encountered in the United States, and for all types of construction normally employed where adequate space is available. It is especially important that maximum insulation thickness should be used where the construction itself offers the least resistance to the passage of heat, or where temperature differentials are highest, as in attics and roofs.

VAPOR BARRIERS

Wherever construction conditions permit the use of mineral wool in batt or loose form, they likewise permit the installation of a "vapor barrier" membrane on the warm side of the insulation if not already attached to the product as manufactured. The purpose of this vapor barrier is to prevent the passage of moisture vapor from the warm interior of buildings out toward the colder outside air.

This humidity is often mechanically introduced into the building in air conditioning, but in such cases the equipment should be automatically controlled to prevent excessive dampness.

There is also the possibility that the vapor, unless stopped near the warm side, will be impeded in its outward movement by cold surfaces such as the outside sheathing. When the vapor movement is thus retarded by materials on the cold side which offer greater resistance than those on the warm side, under extreme conditions the vapor may be condensed on the sheathing as dampness or frost. The protective value of a vapor barrier applies to all heated buildings, regardless of the type of insulation employed, or whether insulated or not. It also safeguards the insulation and exterior painting against dampness released by fresh plaster or uncontrolled or excessive humidity.

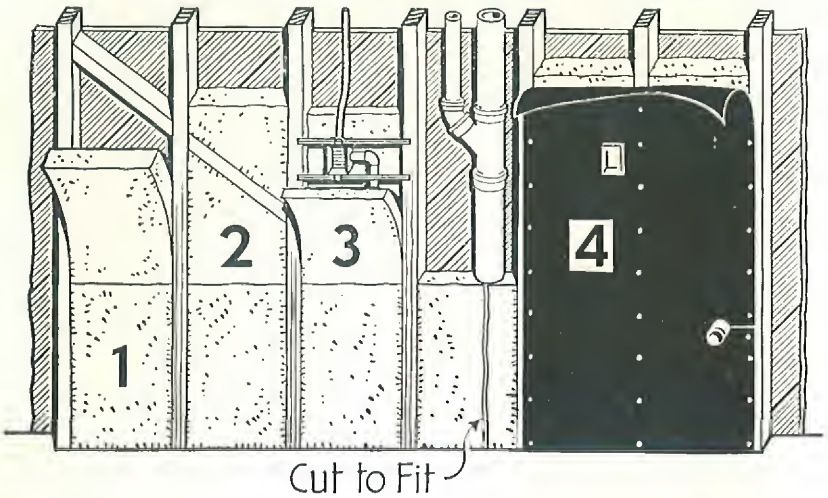
For these reasons the use of a vapor barrier on the warm side of walls, roofs, and exposed floors and ceilings is recommended by the National Lumber Manufacturers Association, the National Paint, Varnish & Lacquer Association, and by the National Mineral Wool Association.

Conversely, it is not desirable to use materials on the cold side of the insulation which collectively have as high a resistance to vapor movement as those used on the warm side.

Heat-Seal Wool is available in batt and strip forms, with a vapor barrier as an integral part of the product. This barrier is in the form of a suitably impregnated paper attached to the wool by adhesives. Heat-Seal batts and strips can, however, be furnished without the vapor barrier, if desired.

When loose wool is to be hand-packed, or when batt forms are used which do not have their own vapor barrier, it is essential in cold climates to cover the inside (warm side) of the insulated areas with a suitable vapor resistant material.

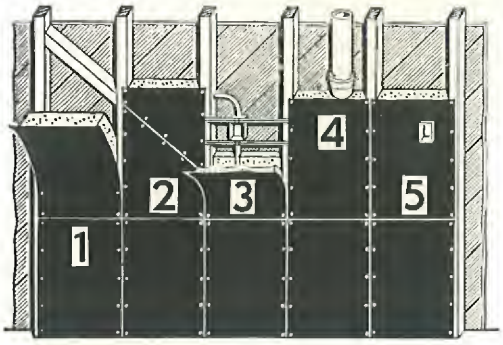
APPLYING BATTS WITHOUT FACTORY-ATTACHED VAPOR BARRIER

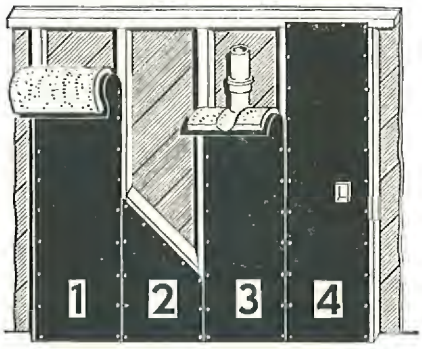


INSTALLATION OF FULL THICKNESS BATTS ONLY

1. Start at bottom of stud space, snugly butting each successive batt. Stuff below floor line for fire-stopping.
2. Cut standard batts to fit angles, corners and irregular spaces.
3. Where electrical cables or conduits obstruct the panel, split the batts, tucking part of the material behind the obstructions and place remainder over the face, except where water pipes are encountered. Put all insulation possible on cold side—none on warm side.
4. When entire area is packed, cover with an approved vapor barrier.

APPLYING BATTS WITH FACTORY-ATTACHED VAPOR BARRIER



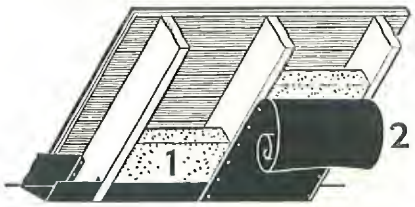


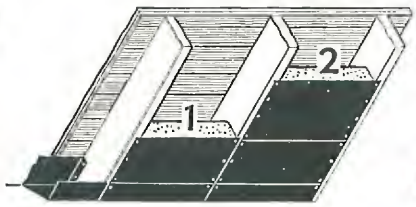
INSTALLATION OF FULL-THICK BATTS

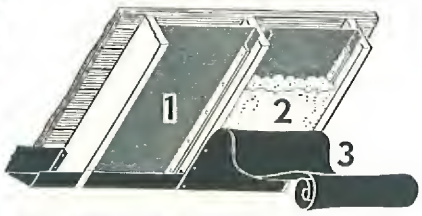
1. Start at bottom of stud panel, snugly butting each successive batt.
2. Cut batts to fit irregular spaces, leaving flange on the vapor barrier for nailing.
3. Batts may be split to work part of the wool under conduit, etc., but vapor barrier should not be cut unless absolutely necessary.
4. Large pipes require removal of some of the wool for packing around inaccessible parts, leaving only vapor barrier.
5. Cut vapor barrier to a snug fit around electrical outlets or protruding pipes, etc.

SEMI-THICK BATTS IN CONTINUOUS STRIPS OR BLANKETS

1. Start at bottom of stud space, using a continuous strip cut to the required length.
2. Cut strips to fit irregular panels, but always provide a flange on the vapor barrier for nailing or to lap over other pieces.
3. Large pipes should not be allowed to interrupt the continuity of the vapor barrier. If necessary, remove some of the wool.
4. Semi-thick batts or blankets can usually be worked over electrical conductors. When outlet boxes or pipes protrude, cut barrier to a snug fit around them.







APPLYING BATTS AND LOOSE WOOL UNDER SLOPING ROOFS

GENERAL NOTE: Seal off end of space between rafters at floor line, to prevent any circulation behind the installed material. This U-shaped seal should be carried up 6" on sheathing and tacked to form envelope to enclose end of material.

WOOL BATTS—FULL OR SEMI-THICKNESS

WITHOUT Integral Vapor Barrier

1. Install first batt at bottom of panel between rafters, pressing in flush with lower edge of rafters.
2. Apply vapor barrier material, cut to length sufficient for entire panel, covering first one or two batts. Add next batt above, pressing down to contact with those below. Continue tacking vapor barrier to hold installed batts until panel is finished.

WITH Integral Vapor Barrier

1. Individual batts should be installed with first batt at bottom of panel between rafters, tacking flanges of vapor barrier to rafters. Batts may be set midway in depth of rafters, tacking flanges to side faces of rafters.
2. Add subsequent batts in same manner, snugly on the batt below.
3. For continuous strip or blanket type, cut strip to full length of panel and install from bottom, securely tacking flanges to edge of rafters.

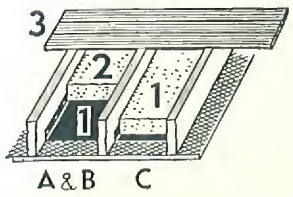
LOOSE WOOL

1. If rafters are 10" or greater, install a backing of vapor-permeable building paper between rafters at depth equal to desired thickness of insulation. Use wood lath to hold edges securely. If 8" or less, fill space.
2. Pack Mineral Wool against the paper backing or sheathing to a density adequate to hold the wool in place.
3. Cover wool with vapor barrier material tacked to edges of rafter adding more wool to fill voids if required. If wool tends to settle, even slightly, when adjacent rafters are vigorously pounded, more wool is needed. A tendency to fluff up and out under vibration indicates a satisfactory density.

EHRET INSULATIONS

TOP FLOOR CEILINGS OR ATTIC FLOORS OVER HEATED SPACE

WORKING FROM ABOVE
(Ceiling finish in place)



A. BATTS WITHOUT INTEGRAL BARRIER

1. Install vapor barrier directly against ceiling finish. Tuck down snugly.
2. Set batts down on vapor barrier, butting closely together.
3. Install flooring.

B. LOOSE WOOL OR GRANULATED WOOL

1. Same as A, 1.
2. Place loose wool or pour granulated wool over vapor barrier to desired thickness.
3. Install flooring.

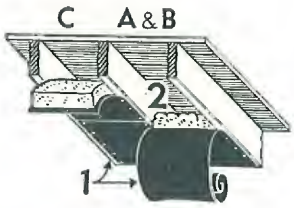
C. BATTS WITH INTEGRAL VAPOR BARRIER

1. Insert batts with vapor barrier down against ceiling finish. Always install vapor barrier (against, or) nearest the warm side of the building, folding flanges up against sides of ceiling beams as shown.

WORKING FROM BELOW
(Attic floor in place)

A & B. BATTS WITHOUT INTEGRAL VAPOR BARRIER

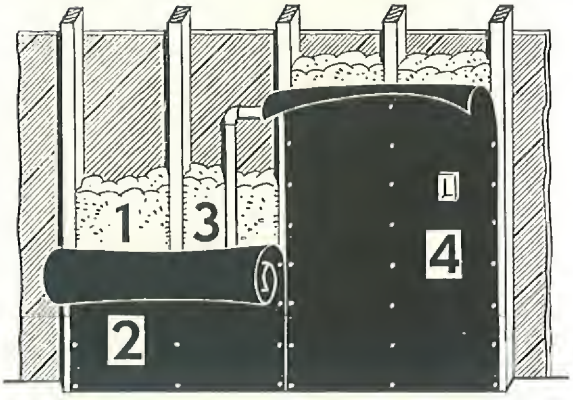
1. Install vapor barrier by nailing to under side of joists before applying lath or ceiling finish.
2. Insert batts progressively as vapor barrier is tacked in place, pushing each unit tightly against those already installed before attaching barrier to hold next batt.



C. BATTS WITH VAPOR BARRIER

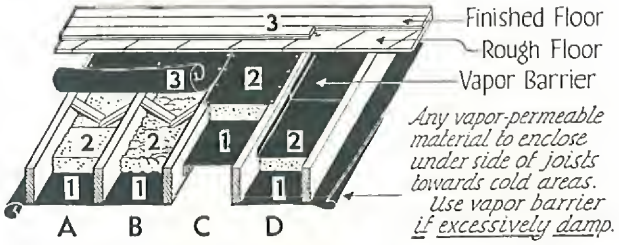
1. Insert batts from below, securely tacking flanges of vapor barrier to under side of joists. Add ceiling finish after completing installation of batts.

LOOSE WOOL IN WALLS



1. Pack loose wool between studs to give firm even pack without voids.
2. After the wool is packed, apply vapor barrier. Tack to studs at not greater than 6" centers.
3. To avoid chance of freezing, do not pack on room side of pipes.
4. Cut vapor barrier to snug fit around outlet boxes or protruding pipes, etc. The vapor barrier should seal in the Mineral Wool.

FLOORS OVER COLD SPACES



A. BATTS WITHOUT INTEGRAL BARRIER

1. Install any building paper which will pass vapor to enclose under side of joists and hold insulation in place.
2. Insert batts between joists, fitting around bridging, piping
3. Apply vapor barrier material lengthwise along top of joists and lay sub-floor.

B. LOOSE OR GRANULAR MINERAL WOOL

1. As above (A).
2. Pack loose wool or pour granular wool, to desired thickness filling around all obstructions.
3. As above (A).

C & D. BATTS WITH INTEGRAL VAPOR BARRIER

METHOD 1. See drawing C.

1. Install a secondary bottom of vapor-permeable building paper to hold mineral wool in place.
2. Install batts as shown. Lay flooring.

METHOD 2, Drawing D.

1. As for A.
2. Install batts with flanges of vapor barrier turned up along sides of joists. Avoid breaks in vapor barrier.
3. Apply flooring.

INSULATING VALUE OF MINERAL WOOL

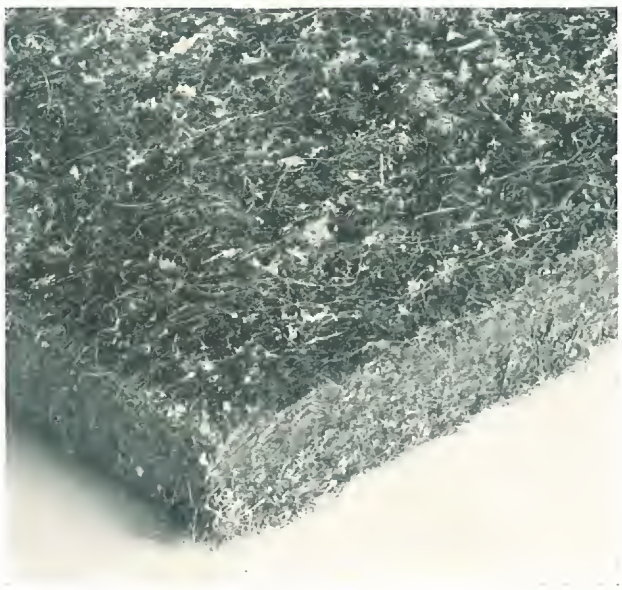
To find the overall thermal transmission U of a wall, roof, or floor section add the Resistances of all the materials comprising the construction (for the actual thicknesses employed) including the film resistance of still air indoors and air moving at 15 m.p.h. outdoors, and divide the sum into 1.00 (the reciprocal). See A.S.H.V.E. Guide, current edition, for resistances and resistivities of building materials, but note that the latter must be adjusted for the actual thicknesses to be used. This is important.

Any mass insulation has approximately the same value per inch of thickness. With mineral wool, full-thick or semi-thick batts may be employed, in accordance with requirements, regardless of any excess depth of the air space involved.

	Conductance C	Resistance R
(1) Full thickness mineral wool batts or hand packed stud spaces 3⅝" thick—no remaining air space	.07	13.41
(2) Semi-thick batts or blankets or hand packed in shallow spaces as between furring strips, nominal 2" thick,—no remaining air space	.135	7.40
(3) Full thickness wool (3¾") between deep rafters or floor joists, including allowance for one enclosed air space over ¾"	.07	14.32
(4) Semi-thick batts or blankets 2" thick, including allowance for one enclosed air space over ¾"	.12	8.31

EHRET'S SOUND CORRECTION FELT . . .

Ehret's Sound Correction Felt was developed in answer to a need for a low-cost, easily applied acoustical material for use in the architectural and building fields. It is applied to the surfaces of walls and ceilings to improve the acoustical properties of the space involved, and it is also installed within walls, ceilings and partitions to minimize the penetration of noise. It is a highly efficient and thoroughly satisfactory material for a broad range of both acoustical and sound isolation requirements.



Manufactured by the punched-felt process, Ehret's Sound Correction Felt consists basically of approximately equal proportions of specially treated goat hair and certain grades of asbestos fibres. These materials are punched through a burlap core which forms a structurally strong web in the center of the finished felt.

Sound absorbing coefficients, based on typical installations of Ehret's Sound Correction Felt, are as follows:

Thickness of Felt	Sound absorbing coefficient
½″	.29
¾″	.405
1″	.535

Sound wave frequencies of 512 were used in obtaining these sound absorbing coefficients.

Ehret's Sound Correction Felt is furnished in rolls of 40″ standard width, each roll containing 48 lineal feet (160 square feet) of material. Thicknesses and weights are as follows:

SOUND CORRECTION FELT		
Thickness	Wt. per sq. ft.	Gross wt. per roll
½″	6 ounces	72 lbs.
¾″	9 ounces	103 lbs.
1″	13 ounces	135 lbs.

Sizing and Cement

Special Sizing and Cement have been developed for use in attaching Ehret's Sound Correction Felt to wall surfaces. These materials are available in 1, 5, 10, 25, 50 and 100-lb. containers.

Application Methods

Room temperatures should always be 60° F. or higher when applying Ehret's Sound Correction Felt to wall surfaces. The surfaces to which the felt is to be applied should always be thoroughly cleaned, properly prepared and dried. Oil painted surfaces should be scratched with a wire brush, water color or calcimined surfaces should be washed clean, metal surfaces should be free from grease or oil and new plaster surfaces should be thoroughly dry.

The felt should be unrolled and allowed to flatten before it is applied. If a finishing fabric is to be applied to the felt after it has been cemented onto the wall, the side of the felt on which the fabric is to be attached should be carefully dampened with water. In dampening one side of the felt, care should be taken that the other side is kept dry, as moisture might cause trouble in cementing the felt to the wall.

Surfaces to be covered with felt should be given a coat of the sizing which has been thinned with water to a consistency of light cream. After the sizing has been permitted to dry for one hour, the special cement, which should be thinned with one part of denatured alcohol to two parts of cement, should be painted generously onto the sized surface. The felt should be pressed smoothly onto fresh cement within five minutes after its application. Joints in the felt should be tightly butted and cemented with un-thinned sizing and all surfaces of the freshly applied felt should be rolled to establish a proper bond with the structural backing.

Various materials can be applied to the surface of this felt for a finish. Information on finishes will be furnished on request.

When it is desired to use Ehret's Sound Correction Felt within walls, ceilings or partitions, it should be installed as a blanket, in one or more layers, during construction. The felt should completely cover the area involved, and it should be supported to prevent sagging or dropping.

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EHRET
INSULATIONS

Strips of Isolation Cork can be seen under the right hand supports of the gas mixing machine shown above. The cushioning effect of this material noticeably reduces noise and vibration, and will prolong the service life of the equipment.

EHRET'S ISOLATION CORK . . .

Made specifically for use in deadening the sound and vibration of power and machine units, Ehret's Isolation Cork is extremely efficient and practically everlasting. It is used in power houses, machine shops, factories, hotels, office buildings, ships and many other places where it is desirable to reduce the disturbing and destructive vibration of motors, internal combustion engines, compressors, presses and similar equipment.

In manufacturing Ehret's Isolation Cork, the raw cork is granulated, screened, compressed into molds and baked at a temperature that welds the individual particles into a firm, strong block of the desired characteristics. These blocks may be cut and worked in the same manner as ordinary corkboard.

The methods of installing Ehret's Isolation Cork vary in accordance with size, weight and type of machine, operating speed, anchorage requirements and similar factors. Ehret engineers will be glad to make recommendations for specific conditions.

Densities

Ehret's Isolation Cork is made in three different densities for use under light, medium and heavy unit loadings. In general, the lightest density is suited for use with small motors, fans and other relatively light equipment. The medium density should be used with medium unit loadings and the heavy density material should be installed for large, heavy presses, engines, compressors, motors and similar large unit weight loadings. The accompanying table of compression data is based on 2" thick Isolation Cork and is offered as a guide for determining the most desirable density to use in a particular installation.

Sizes and Thicknesses

Made in standard 12" x 36" units, Ehret's Isolation Cork can be furnished in thicknesses of 1, 1½, 2, 3 and 4 inches. All thicknesses are made in the light, medium and heavy densities.

Packaging

Standard cartons of Ehret's Isolation Cork contain 72 board feet of the material. Average shipping weights per board foot of the 3 densities are as follows: Light density—1.25 lbs., Medium density—1.45 lbs. and Heavy density—1.75 lbs.

EHRET'S ISOLATION CORK

LOADING in pounds per sq. ft.	DEFORMATION, in inches		
	Light Density	Medium Density	Heavy Density
5000	.20	.15	.11
10000	.53	.35	.26
15000	.80	.55	.43
20000	.95	.73	.58
25000	. . .	.85	.70
30000	. . .	.94	.79
35000	. . .	. . .	.86

EHRET

ASBESTOS

FIBRES and TEXTILES

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. AF 600

Printed in U. S. A.

This photograph shows veins of Chrysotile asbestos in the serpentine rock as it is mined. On crushing, this asbestos will be carefully picked out by hand for separation into Crude fibres.

ASBESTOS FIBRES

Although asbestos has been known since ancient times, it was not until the second half of the last century that its status changed from that of a curious novelty of no particular value to a basic industrial material of great importance. Since this change has taken place, its importance has grown to the point where there are few commercial fields today that do not depend heavily upon one or more asbestos products for operating economy, if not actual existence.

Asbestos is a non-metallic mineral that is found in a limited number of localities that are widely scattered throughout the world. Canada, Rhodesia, South Africa and a few sections in the United States furnish practically all of the asbestos fibres used in this country. The Canadian deposits have always supplied the major portion of our asbestos requirements, while minor amounts are obtained from various other sources.

The kinds of asbestos fibres produced by different mines show wide variations. Chemical analysis, fibre length, structural and physical characteristics differ with nearly every source.

The Canadian mines, with which we are mostly concerned, are the world's greatest producers of Chrysotile asbestos. The South African sources furnish both Crocidolite, or Blue fibre, and the Amosite, or Brown fibre. Since the Canadian Chrysotile fibre is of such importance to the American asbestos industry, the following general description of its production may be of interest.

Canadian Chrysotile asbestos occurs in the form of veins ranging as high as three or four inches in thickness, that are scattered through serpentine rock. This rock, commonly called the matrix, as well as the asbestos itself, is igneous in origin. In their original state, the thicker veins of asbestos seem hard and rock-like in character, with a light grayish translucent appearance. On close inspection, however, the asbestos rock shows a structure consisting of closely compressed silk-like fibres that generally run from face to face of the vein. These fibres can be readily picked loose from the asbestos rock and separated from each other.

The serpentine matrix containing the asbestos veins is quarried from open pits or dug from underground mines. Upon delivery to the crushers, this rock is broken up sufficiently to permit the thicker veins of asbestos to be picked, or cobbed, by hand from the matrix. This hand-cobbed asbestos rock is then ready to be sent to the fiberizing process for separation into the fibre classification known as Crudes. After the Crudes have been cobbed out, the matrix is milled and processed to remove all of the asbestos fibre. These fibres are classified as Milled.

To simplify the specification of particular grades of Chrysotile fibre, a grading method for standard classification of asbestos fibres was developed some years ago by the Canadian producers. Classification testing equipment consists of three standard

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screen boxes and a tray that are stacked one over the other with the largest size screen at the top and ranging down to the tray at the bottom. The screen stack is vibrated on a shaking table under standard conditions.

In making a fibre classification test, 16 ounces of the fibre to be graded are placed on the top screen and the whole unit then vibrated. After the vibration, the fibres remaining on each of the three screens and tray are weighed. The results are given as the weight of fibre remaining on the various screens and tray. For example, a test on a fibre of unknown classification showed 7 ounces on the top screen, 7 ounces on the second screen, 1.5 ounces on the lower screen and 0.5 ounces in the tray. The result is written as 7.0—7.0—1.5—0.5, which identifies this fibre as a 3-F spinning or textile fibre (see table, Sheet No. AF 602).

The standard grades of Chrysotile asbestos fibres are, on occasion, processed in several ways. Carding, willowing, blending and mixing, convert the standard fibres into special grades. These special grades are used for various industrial purposes and are classified under the name of Prepared fibres. Typical examples of Prepared fibres are:

Carded Crudes—Nos. 1CF, 2CF and 12CF.
Carded Milled Fibres—all types group 3 fibres.
Willowed Fibres—Nos. 8, 10 and 11.
Pakfibre—pure, long, Amosite fibres.

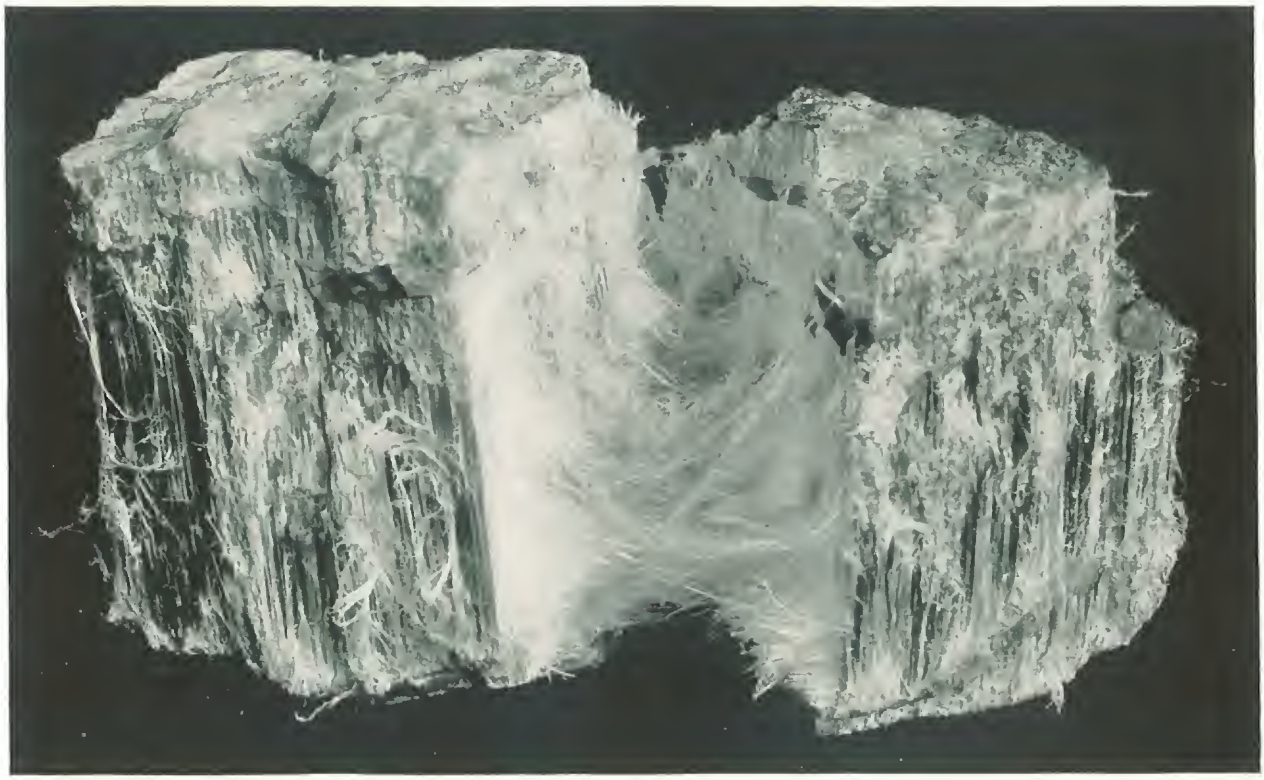
In the manufacture of asbestos products, experience has shown that some fibres are economically or physically best suited for specific needs. The table of Asbestos Fibre Recommendations shown on the back of Sheet No. AF 602 will serve as a guide for those who use or specify fibres. This table, of course, lists but a few of the countless uses for asbestos fibres.

In addition to classification by fibre length, there are other qualities to be considered when choosing a fibre for a particular need. Flexibility of the fibre as well as chemical composition, impurities of a metallic character and electrical and heat-resistant characteristics are often times of particular importance.

Arizona Chrysotile Asbestos

The chemical analysis of Arizona Chrysotile, as well as the physical structure of the fibres, is similar to that of the Canadian Chrysotile. The major difference in these two fibres is in percent of iron content. The Canadian grades have approximately 2.1% ferrous content while the Arizona Chrysotile usually contains only about 0.5% ferrous impurities.

Since the Arizona mines are somewhat inaccessibly located, the production of Arizona Chrysotile is not very extensive. It is used mainly for conditions requiring an asbestos of low iron content such as in electrical work and certain filtering processes, and occasionally for the manufacture of electrical yarn and tape.



This Chrysotile asbestos rock has been split to show its fibrous structure.

Typical sample of Crocidolite asbestos

Crocidolite Asbestos

This South African asbestos, which is frequently called Blue asbestos, is noted for its great resistance to acids. Because of its chemical inertness, it is often used in the manufacture of textiles, packings and filters that are likely to be exposed to the action of acid or caustic chemicals.

Typical sample of Amosite asbestos

Amosite Asbestos

Also produced in South Africa, Amosite fibre is a ferrous silicate material that contains quantities of magnesium and occasionally sodium. It is brownish in color and the fibre structure is considerably different from that of types previously mentioned, the individual fibres being longer, less flexible and somewhat harsh and brash in texture.

This type of fibre is used in the manufacture of certain asbestos insulating materials. When used as an insulation, however, the Amosite fibre has a higher thermal conductivity than the Chrysotile asbestos, and consequently thermal efficiencies are lower.

Certain grades of Crude Amosite fibre are sometimes used as fillers in asbestos blankets and as a fireproof material for packing expansion joints.

ASBESTOS FIBRE CLASSIFICATIONS

Showing Canadian Standard Grade Designations

Group No.	Standard Grade Designation	Guaranteed Minimum Shipping Test	Description
		CRUDE FIBRES	
1	Crude No. 1	Basically consists of Crude fibres ¾" or greater in length.	
2	Crude No. 2	Basically consists of Crude fibres of ⅜" to ¾" in length.	
	Crude, Run-of-Mine	Consists of unsorted Crude fibres.	
	Crudes, Sundry	Consists of Crudes, not otherwise specified.	
		MILLED FIBRES	
3	3-D 3-F 3-K 3-M 3-R 3-T 3-W 3-Z	8– 6–1 –1 7– 7–1.5 – .5 4– 7–4 –1 2– 9–4 –1 2– 8–4 –2 1– 9–4 –2 0–10–4 –2 0– 8–6 –2	Spinning or Textile fibres. Consists of fibres testing 0-8-6-2 and over.
4	4-D 4-F 4-H 4-K 4-L 4-M 4-R 4-T 4-Z	0–5–10 –1 0–3–12 –1 0–5– 8 –3 0–4– 9 –3 0–3–10 –3 0–4– 8 –4 0–3– 9 –4 0–2–10 –4 0–1– 9.5 –5	Commonly known as Shingle fibres. Consists of fibres testing below 0-8-6-2 to and including 0-1.5-9.5-5.
5	5-D 5-F 5-K 5-M 5-R 5-T 5-Z	0– .5–10.5 –5 0–0 –13 –3 0–0 –12 –4 0–0 –11 –5 0–0 –10 –6 0–0 – 9 –7 0–0 – 8 –8	Commonly known as Paper fibres. Consists of fibres testing below 0-1.5-9.5-5 to and including 0-0-8-8.
6	6-D	0–0–7–9	Commonly known as Waste fibres. Consists of material testing below 0-0-8-8 and above 0-0-5-11.
7	7-D 7-F 7-H 7-K 7-M 7-R 7-T	0–0–5–11 0–0–4–12 0–0–3–13 0–0–2–14 0–0–1–15 0–0–0–16 0–0–0–16	Commonly known as Shorts or Cement Stock. Consists of material testing 0-0-5-11 and below.
8	8-S	No test—weight 35 to 75 lbs. per cu. ft.	Commonly known as Sand. Consists of such asbestos mill products as sand weighing over 35 pounds and under 75 pounds per cubic foot, loose measure, containing a preponderance of rock.
9	9-T	No test—weight 75 lbs. or more per cu. ft.	Commonly known as Gravel or Stone. Consists of such asbestos mill products weighing 75 pounds and over per cubic foot, loose measure.

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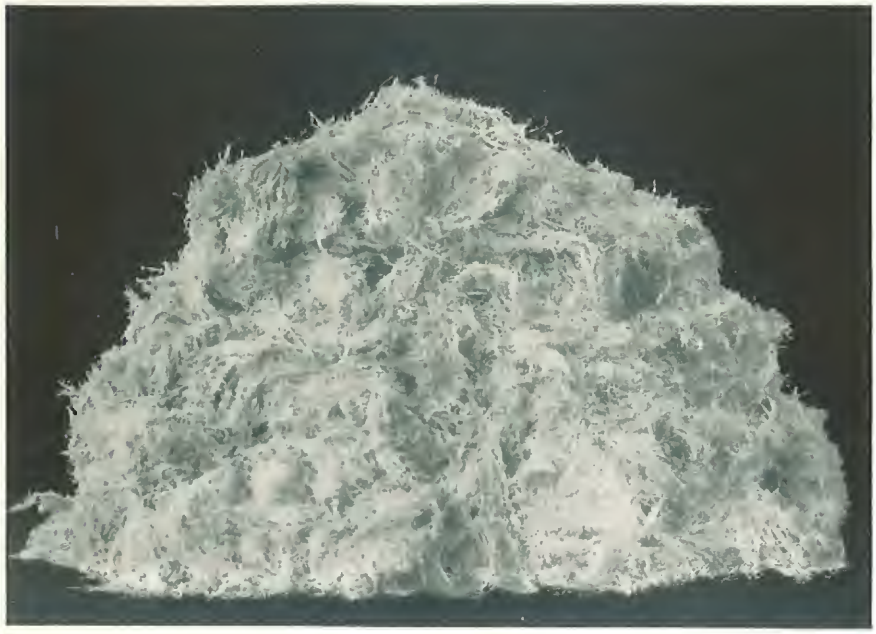
INSULATIONS



EHRET'S ASBESTOS FIBRES

All types and grades of asbestos fibres can be furnished by the Ehret Company. In addition to supplying specified fibres, Ehret engineers will be glad to assist in the problems relating to the choice and use of asbestos fibres. Special grades will be compounded when desired and unusual fibre requirements will be given the full benefit of our many years of experience in the asbestos and insulation industry.

Packing and Shipping Information

With exception of the Amosite fibres, all grades of asbestos fibres are shipped in strong jute bags containing 100 lbs. each. Bags of Amosite fibres contain 80 lbs. each. All bags are plainly marked as to the grade of fibres contained, in accordance with the Canadian Standard Markings.

Certain of the fibres contained in Group 7, such as 7-M, which are commonly sold as Asbestos Cement for insulating purposes, are also available in paper bags of 50 lbs. each.

In order to determine railroad rates applying on shipments of fibre from the mines to destinations in the United States, the following railroad classification of the minimum requirements for carload quantity is given.

FREIGHT CLASSIFICATION	
Fibres	Minimum Carload Quantity
No. 1 and No. 2 Crude Groups 3, 4 and 5—Fibre	20 short tons
Group 6—Waste Groups 7, 8 and 9—Shorts	30 short tons

ASBESTOS FIBRE RECOMMENDATIONS	
Usage or Product to be Manufactured	Fibre Classifications
Blanket Asbestos Fillers	Pakfibre, 3-K.
Blocks, Concrete	7-K, 7-M, 7-R.
Brake Linings or Blocks, Moulded	4-T, 5-D, 5-M, 5-R.
Cements, Roofing	5-M, 5-R, 6-D, 7-D, 7-F, 7-H, 7-K, 7-M.
Caulking Compounds	7-D, 7-K, 7-M.
Clutch Facings, Moulded	4-T, 5-D, 5-M, 5-R.
Concrete, Flooring or Nailing	7-K, 7-M, 7-R.
Asbestos and Portland Cement Products, Shingles, Lumber, Roofing, Pipe, Conduit, Wallboard, Tile, etc.	4-M, 4-K, 4-L, 4-R, 4-T, 5-D, 5-M, 5-R, 6-D, 7-D, 7-M.
Electrical Insulation	No. 1 and No. 2 Crude.
Facings and Paddings	Carded No. 2.
Filtration Purposes	No. 1 and No. 2 Crude, A-No. 7, Carded No. 10, Willowed No. 8.
Grease Compounding	7-RF, Willowed No. 8.
Flooring, Tiles and Composition	7-D, 7-F, 7-H, 7-M, 7-R, 7-RF, 8-S.
Insulation, High Pressure	3-K, 3-R, 3-T.
Insulation, Asbestos Cements	7-D, 7-F, 7-H, 7-K, 7-M, 7-R, 7-T.
Millboard, Asbestos	5-M, 5-R, 6-D, 7-D.
Moulded, Cold Products	5-M, 5-R, 6-D, 7-D, 7-K, 7-R, 7-RF.
Moulded, Hot Synthetic Resin	7-RF.
Packings, Compressed Asbestos Sheet	3-R, 3-T, 4-K, 4-L, 4-M, 4-R, 4-T.
Packings, Furnace Expansion Joint	Pakfibre, Willowed No. 11
Paint, Asphalt Roofing or Plastic Wall	7-D, 7-F, 7-H, 7-K, 7-M, 7-R, 7-T.
Paper, Asbestos Products	5-D, 5-M, 5-R, 6-D, 7-D.
Rubber Compounding	Willowed No. 11, Pakfibre.
Wire-wiping Purposes	Willowed No. 8, Wick No. 40.
Yarn, Asbestos Spinning	No. 1 and No. 2 Crude, 3-K, 3-R, 3-T.

ASBESTOS TEXTILES

Asbestos textiles are made in a variety of forms to satisfy a broad range of industrial and manufacturing requirements. They are heat and fire-resistant and have many other physical and chemical characteristics that are found in no other material. Only certain grades of asbestos fibres are suitable for use in the manufacture of textiles. Generally speaking, the No. 1 and No. 2 Crude fibres and the Spinning fibres down to and including classification 3-T are the fibres used as the basic textile materials.

In the manufacture of asbestos textiles the fibres are first put through a combing process that lays all fibres parallel to each other. This operation, known as carding, is a fundamental step in the manufacture of all fibre base textiles. After carding, the fibres are formed into rovings, yarns and threads which, in turn, can be woven and braided.

Textile Grading

The use of textiles made from asbestos fibre *only* is somewhat limited. Most asbestos textiles, consequently, contain a certain amount of cotton fibre. This cotton content improves the spinning characteristics of the asbestos and increases the tensile strength of the resulting product. The table below shows the standard grading system used in the classification of asbestos textiles.

STANDARD ASBESTOS TEXTILE GRADES

Grade	Asbestos Content	No Guarantee Above	Approximate Temperature Limit
Commercial	Up to but not including 80%	79.9%	350° F.
Underwriters	80% and up to but not including 85% (carbon content 7½% to 10%)	84.9%	400° F.
AA	90% to 92%	90%	600° F.
AAA	95% to 96%	90%	850° F.
AAAA	100%	....	950° F.

NOTE: The only material added to the asbestos fibre in the first four grades listed above is cotton fibre.

Ferrous and Non-Ferrous

Practically all asbestos fibres contain a small amount of iron. The percentage of iron content is of minor interest to most users of asbestos textiles, but in industries such as the electrical, low iron-content asbestos is required. As a consequence, asbestos textiles are classified as "ferrous" and "non-ferrous." Canadian asbestos is nearly all of the ferrous classification and the non-ferrous fibres are furnished mainly by the Arizona mines. The following table shows the range of iron content for these two classifications.

CLASSIFICATION BY IRON CONTENT

Type	Maximum of Total Iron	Maximum of Magnetic Iron
Ferrous	6%	2%
Non-ferrous		
Underwriters Grade	1.75%	.75%
AA Grade	2. %	1. %

All asbestos textiles are normally furnished in ferrous grade asbestos. When so specified, however, textiles can be furnished in the non-ferrous grade.

Plain and Metallic

The classification of an asbestos textile product as "plain" means that it contains no metal insertions. A "metallic" textile is one that contains small wires that are twisted into the asbestos to increase tensile strength. These wires, usually from .007" to .008" in diameter are in most cases furnished in brass. Other metals such as lead, zinc, Monel metal and nichrome can be inserted if desired. Textile products of all types are available in both plain and metallic forms. Metallic textiles are generally used where additional strength is desired.

The Ehret Company can furnish a full range of standard asbestos textiles and textile products. Special asbestos textiles are available for those whose requirements are not met by standard items. The Ehret Company and the engineers will be glad to assist in the development of special textile products to answer individual needs.

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EHRET'S CARDED ASBESTOS FIBRES . . .

The uses for carded asbestos fibres are many. Such uses include the manufacture of sheet packings; filters; gas-burner log facings; asbestos snow for decorative purposes, and as a protective agent in the manufacture of glass.

Carded fibres are pure asbestos which has been screened and combed by means of a special carding machine. They contain no cotton or other organic material and are obtainable in various Crude and Spinning grades, both mixed and unmixed.

Commonly used types of carded fibres are listed in the table below. Mixtures of carded fibres of any length are available on order.

Fibre Designation	Description
No. 1 CF	Carded Fibres of No. 1 Crude asbestos.
No. 2 CF	Carded Fibres of No. 2 Crude asbestos.
No. 12 CF	A mixture of No. 1 and No. 2 Carded Crudes.

Various grades of carded Spinning fibre can be furnished, straight or mixed, to suit particular requirements.

Packaging

Ehret's Carded Asbestos Fibres are packed in 50 and 100-lb. cartons and barrels. Also available, when desired, in 1-lb. packages.

EHRET'S ASBESTOS ROVING . . .

Asbestos Roving is made by rubbing carded fibres into a single strand without twist. Roving is soft, light and flexible and has excellent covering qualities. High tensile strength is not usually required in a roving as the principal use for this material is in the covering of electrical wires and cords. Such asbestos roving-protected cords are widely used on resistance heaters, irons and other electrical equipment that present hazards to the supply wires. A number of types and grades of asbestos roving are available as follows:

Reinforced Roving—containing a cotton yarn core.

All Grades—of asbestos are available in the form of rovings. The Underwriters and AA grades are considered standard but other grades can be furnished.

Ferrous Asbestos—will be furnished unless otherwise specified.

Non-Ferrous Asbestos—is available on special order.

Packaging

Ehret's Asbestos Roving is wound on cones and cheeses that are individually wrapped in paper and packed in boxes or cases as desired.

EHRET'S ASBESTOS YARN . . .

Asbestos yarn is the basic material used in the manufacture of a great number of asbestos products. It is woven into tapes, tubings, cloth and other textiles; wrapped and braided into electrical wires and cables; incorporated into the fabrication of brake linings, packings and flexible metal hose, and used by itself as a packing for spark plugs, small valves and stuffing boxes.

Asbestos yarn consists of asbestos fibres that have been spun and twisted into continuous strands. Yarn is made in a wide range of types and sizes. The "cut" or "count" of a yarn is a term frequently used in yarn specification. These terms signify the number of 100 yards per pound of single-ply yarn. That is, a 10 cut single-ply yarn will measure approximately 10 x 100, or 1000 yards of yarn per pound. In estimating the approximate number of yards per pound of multi-ply yarn, the cut should be divided by the number of plies. For example, an 18-cut—3-ply yarn will measure approximately 18/3 x 100, or 600 yards per pound. In calculating the actual yardage per pound of multi-ply yarn, an allowance should be made for the contraction in length due to twist. All measurements based on the cut basis are approximate, and variations up to 10 or 15% are to be expected.

The following information on asbestos yarn indicates the many available types of this material.

Standard Cuts—consist of 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 and 32.

Plies—yarn is made in single-ply, consisting of one strand only, and in multi-ply form, consisting of 2, 3, 4, 5, 6 or more plies.

Plain Yarn—a term applied to yarn that contains no metallic wire.

Metallic Yarn—is made with metal wires, usually brass, that are inserted into the asbestos yarn. Metals other than brass are available. Numerous combinations can be furnished such as 2-ply asbestos with one wire, 1-ply asbestos with two wires, 4-ply asbestos with three wires, etc.

All Grades—of asbestos from commercial through AAAA are available in yarn form.

Ferrous Asbestos—this type furnished unless otherwise specified.

Non-Ferrous Asbestos—available on request.

Special Yarns—can be furnished on order. Yarns can be coated or sized as specified. Organic fibre centers will be furnished when desired. Other special yarns will be manufactured to specification of strength, diameter, twist, etc.

Steam Hose Yarns—having extremely high tensile strength and great uniformity, are available in a number of sizes and types.

YARN NOTATION SYSTEM

A numerical notation system is used to simplify the specification and ordering of asbestos yarns. The first part of the yarn number represents the cut, the next digit the number of plies, and the last digit the number of metallic wires. The following examples illustrate the basis of this yarn notation system:

Type of Yarn	Yarn No.
8-cut, 2-ply, plain yarn	820
12-cut, 3-ply, plain yarn	1230
10-cut, 2-ply, metallic yarn with 1 wire	1021
14-cut, 3-ply, metallic yarn with 2 wires	1432

In addition to specifying a yarn by means of the numerical system, the grade of asbestos desired should be given. If a non-ferrous type of asbestos is desired, orders should be marked accordingly because, unless otherwise noted, ferrous asbestos will be furnished.

Packaging

Asbestos yarns are furnished, universal winding, in the following two ways:

1—On $\frac{5}{8}$" x $6\frac{1}{2}$" paper tube cores. Yarn wound with 1, 2 or 3 ends, as desired, the traverse running from 2" to 6" and the over-all diameter of the wound yarn ranging from $1\frac{7}{8}$" to 5". Weights range from 2 to 5 pounds per unit and the

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measured weight of yarn includes the weight of the paper tube.

2—On Braider tubes containing approximately ¼ lb. net weight of yarn.

Asbestos yarns are packed in cartons containing approximately 275 lbs. of plain yarn, or 300 lbs. of metallic yarn.

EHRET'S ASBESTOS THREAD . . .

The uses for asbestos thread or twine include sewing asbestos cloth into curtains, blankets, gloves and garments. It is also used for tying gas mantles. Asbestos thread is made by twisting 2 or more uniform plies of high quality asbestos yarn into a thread which is then finished hard, thoroughly sized and waxed. Yarn of any cut can be made into thread or twine, but the most commonly used sewing threads are made from 12 and 14-cut yarn. For tying gas mantles, thread made from 26 and 28 cut yarn is generally used.

All grades of asbestos are available in thread and twine form, and can be furnished Plain or Metallic, as desired. Wound on tubes in 1 and 5-pound weights.

ASBESTOS THREAD, PLAIN

Standard Sizes	Approx. Yds./lb.
12-cut—2-ply	550
12-cut—3-ply	360
12-cut—4-ply	280
14-cut—2-ply	650
26-cut—2-ply	1175
28-cut—3-ply	850
28-cut—4-ply	675

EHRET'S ASBESTOS CORD . . .

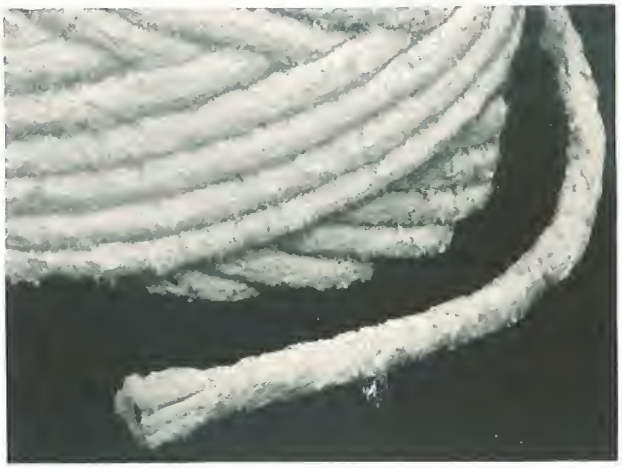
Asbestos cord is used principally in glass and chemical plants to suspend heated metals, retorts and crucibles. It is made, in all grades of asbestos, by twisting multi-plies of tightly spun plain yarn to the desired size. Asbestos cord is generally coated or sized to provide a smooth, hard finish, but unsized cord is also available. Spliced and unknotted endless cord can also be furnished.

Wound in continuous lengths on 1 pound tubes and 5, 10, 25 and 50 lb. spools, standard sizes of asbestos cord are listed in the table below.

APPROXIMATE NUMBER OF LINEAL FEET PER POUND

Diameter of Cord	1/16"	3/32"	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"
Sized.....	558	272	134	105	80	39	30	16	9
Unsized.....	584	280	138	110	84	44	33	17	10

Asbestos Wire-Wiping Cord is specially designed for use in the wire industry. It is made of selected fibre yarn in the same general manner as regular asbestos cord, but is furnished unsized. When



wearing qualities are of major importance, a firmly twisted cord is required. A cord with a soft twist should be used to minimize the probability of scoring metal surfaces. Type of twist desired should be specified.

Commercial grade Wire-Wiping Cord is usually furnished, but other grades are available. Packed in same manner as asbestos cord.

EHRET'S ASBESTOS CLOTH

Asbestos yarn is woven into 3 types of asbestos cloth, namely, standard, twill and herringbone weaves. Standard weave cloth is used for a broad range of commercial and industrial purposes, while the twill and herringbone weaves, which are woven close and tight, are used in the manufacture of asbestos safety clothing products.

Ehret's Asbestos Cloth is available in a number of grades, styles and sizes in accordance with the following:

Grades—all weaves are available in any grade from commercial through AAAA.

Plain and Metallic—cloths of all types are available, with or without brass wire insertions. Special metallic cloths include wire insertions of lead, copper, zinc, Monel metal, Nichrome and stainless steel.

Widths—are 36″ and 40″ standard. Style 225L laundry cloth is also available in 50″, 72″, 90″, 122″ and intermediate widths. All styles of asbestos cloth can be furnished in widths up to 122″ where quantities are sufficiently large.

Specification Cloth—can be manufactured to meet requirements of specified weave, texture, weight, thickness, tensile strength and asbestos content.

Packaging

Asbestos cloth is furnished in standard rolls containing 50, 60 or 100 lineal yards. Generally packed 3 rolls to a bale.

The styles of asbestos cloth listed in the accompanying table are available in all grades. The grade of asbestos desired should be noted with each style number.

STYLES OF ASBESTOS CLOTH

Weave	Style No.	Approx. Lbs. Per Sq. Yd.	Warp	Filler	No. of Ends
PLAIN CLOTH					
Standard	110	1.10	1420	1410	11 x 12
	130	1.30	2420	2420	25 x 11-12
	150	1.50	1020	1020	9 x 9
	162	1.62	1320	1310	23 x 10½
	175	1.75	1420	1420	20 x 10
	186	1.86	1420	1420	23 x 10
	*200	2.00	1220	1220	21 x 8
	225L	2.25	1020	1020	20 x 10
	*225	2.25	1220	1220	21 x 10
	232	2.32	1220	1020	21 x 10
	*250	2.50	1220	1020	21 x 10
	262	2.62	1230	1230	20 x 8
	*300	3.00	1030	1030	18 x 9
	325	3.25	1030	1020	20 x 10
	350	3.50	820	820	25 x 7
	415	4.15	1420	1420	45 x 18
Twill	300T	3.00	1320	1320	28 x 12½
	333T	3.33	1220	1220	36 x 12
	400T	4.00	620	620	21 x 10
Herring-bone	22510	2.25	1020	1020	21 x 10
	22514	2.25	1420	1420	30 x 14
	22516	2.25	1620	1620	36 x 14
	22518	2.25	1820	1820	40 x 14
	25010	2.50	1020	1020	21 x 12
	25018	2.50	1820	1420	40 x 14
METALLIC CLOTH					
Standard	1620	1.62	1211	1211	20 x 10
	2000	2.00	1011	1011	20 x 10
	2400	2.40	1021	1011	18 x 9
	*2700	2.70	1022	1011	18 x 9
	*2750	2.75	1021	1021	20 x 10
	*3000	3.00	1022	1021	18 x 9
	3004	3.00	1022	1022	16 x 8
	*3300	3.30	1022	1022	18 x 9
	3500	3.50	1022	1021	20 x 9
	4300	4.30	932	932	16 x 8
Twill	3510T	3.51	1022	1021	20 x 11

NOTE:—The asterisk (*) denotes those styles which are regularly stocked in Commercial and AA grades. The "Warp" and "Filler" columns show the cut and ply of the Yarn used (see Yarn Notation System on Data Sheet No. 604). The "Number of Ends" column gives the number of ends per lineal inch in the warp and filler respectively.

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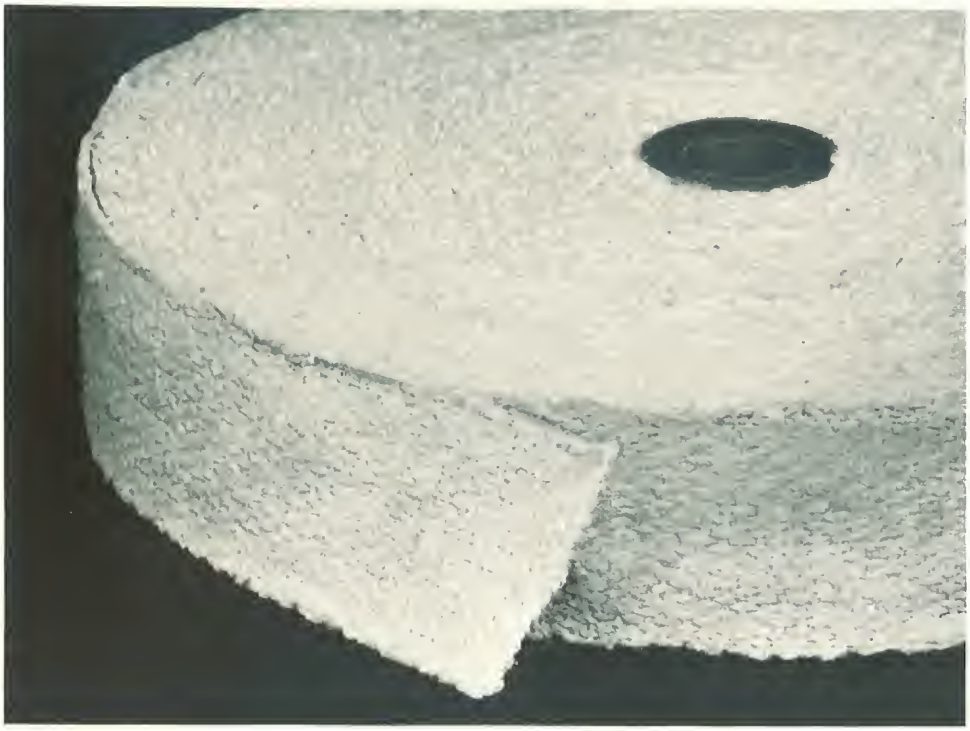
EHRET INSULATIONS

TYPICAL USES OF ASBESTOS CLOTH

with recommendations of commonly used Styles and Grades

Grade abbreviations are Com.—Commercial, Und.—Underwriters, AA, AAA and AAAA.

Uses	Description	Style No.	Grade
Awnings	For this purpose, twill weave cloths are preferable and are specially made, tightly woven and weigh approximately 2 lbs. per sq. yd.	To Specif.	Com.
Belts	(1) For use on blue print machines reduces fire hazard and outlasts cotton belts, high tensile strength and close texture.	175 250 225	Com. Com. Com.
	(2) For use in stereotype mat dryers, have firm tension with minimum stretch.	2750 2700	AA AA
Blankets	(1) For annealing and welding, and for covering large metal castings, where an asbestos filled blanket is not used.	300 250 225	AAA AA Com.
	(2) For smothering fires in oil refineries, fire departments, filling stations, dry cleaners and chemical plants.	225 250	Com. Com.
	(3) For the manufacture of removable insulation on turbines and hot oil lines.	225 250	As Specif.
Brake Lining	Used in the manufacture of folded and stitched industrial brake lining and blocks.	3300 3000	Com. Com.
Clothing	Used in the making of safety clothing such as gloves, mittens, suits, etc. The tighter herringbone weave is preferred.	225 250	Com. Und. AA
Conveyor Belt Facing	Used to face cotton conveyor belting and to line scoops, chutes and to cover tables in conveyor systems.	175 200 216	AA AA AA
Covers	For insulating covers over glass conveying apparatus, pads and other equipment of this type.	250 225 300T	Com. Und. AA
Curtains	(1) For making curtains used in locomotive cabs, lehrs, dryers;—used as shields to protect welders and workmen, for fire-protecting openings in buildings, divisioning electric sub-stations and warehouses.	225 250	Com. Com.
Curtains (Cont.)	(2) For making theatre and auditorium safety curtains. Each locality has state codes and building ordinances which govern the grades of cloth used.	3000 3004	AA AAA
Diaphragm Cloth	For use in electrolytic cells for the production of oxygen and hydrogen. Tightly woven twill cloths subject to minute inspection are generally used for this purpose.	333T 400T 300T	AAA AAAA
Dust Collection Bags	Used in the collection of dust for the purposes of recovery value and/or health protection. Made to exact specification to suit type of equipment.	To Specif.	As Specif.
Filter Cloths	Used for wet filtration in a wide variety of uses. Cloths of uniform texture are furnished, metallic cloth adds to durability.	2400 2000 325 300	AAA AAA AAAA AAAA
Fenders	Used as mill scale fenders to protect adjusting apparatus in rolling mills from hot scale.	225 250	Com. Com.
Gaskets	(1) For the making of asbestos metallic rubberized gasket cloth.	2700 2000	Com. AA
	(2) For making special gaskets.	225	C or AA
Hoods	As hoods over forge furnaces, a metallic cloth is more serviceable than a plain cloth.	3000 3004 2750	Com. Com. Com.
Jackets	For fireproof jackets over pipe insulation as specified by American Marine Standard and Navy Department.	186 225 250	Com. AA
Laundry Cloth	Used to cover mangles in laundry equipment. Furnished in widths up to 122".	225L	Com.
Packings	For uses in the manufacture of high pressure asbestos rod packings.	225 200 175	Com. AA
Wrapping Glass Rollers	Used to wrap conveyor rollers. To prevent sheet glass from touching the metal.	250 225	Com. AA



EHRET'S ASBESTOS LISTING TAPE . . .

Asbestos listing tape is used as a fireproof protection on electric wires and cables, as a wrapping on internal combustion engine exhaust pipes, for covering small diameter pipes where space does not permit the use of a molded insulation, as a wrapping on exposed hot piping to prevent workmen from accidental burns and for light conveyor and lead-in belts where temperatures are too high to permit the use of cotton fabrics.

Woven from asbestos yarn, listing tape has firm, flexible selvage edges. It is uniform in thickness, width and weave and has excellent tensile strength.

The following information will assist in the specification of listing tapes.

Standard Thicknesses—are .015", .020", 025", $\frac{1}{32}$", $\frac{1}{16}$", $\frac{3}{32}$" and $\frac{1}{8}$".

Widths—ranging from $\frac{1}{2}$" to 3" inclusive in $\frac{1}{4}$" increments. Special widths are obtainable as follows: $\frac{1}{32}$", $\frac{1}{16}$" and $\frac{3}{32}$" thick can be furnished up to 12" in width; $\frac{1}{8}$" thick, up to 6" in width.

All Grades—are available from Commercial up to and including AAAA.

Plain or Metallic—asbestos tapes are available. Plain will be furnished, however, unless Metallic is specified.

Ferrous and Non-Ferrous—asbestos are both available. Ferrous will be furnished unless otherwise specified.

Packaging

Listing tape is furnished in standard rolls containing approximately 100 lineal feet. Special sized rolls are available on order. Tapes of .015", .020" and .025" thicknesses are wound on $\frac{5}{8}$" cores, in rolls of approximately 5" diameter. Tapes of $\frac{1}{32}$" thickness and up are wound on cardboard cores. Rolls are packed in cartons or cases.

ASBESTOS LISTING TAPE
APPROXIMATE NUMBER OF LINEAL FEET PER POUND

Width of Tape Inches	Thicknesses						
	.015" P	.020" P	.025" P	$\frac{1}{32}$" P	$\frac{1}{32}$" M	$\frac{1}{16}$" P	$\frac{1}{16}$" M
$\frac{1}{2}$	310	215	130	140	120	75	60
$\frac{3}{4}$	210	165	100	90	80	55	45
$\frac{7}{8}$	180	140	95	75	70	50	40
1	165	120	85	70	60	40	35
1 $\frac{1}{8}$	150	105	80	65	55	35	30
1 $\frac{1}{4}$	140	95	75	60	55	30	30
1 $\frac{3}{8}$	120	90	70	50	40	30	25
1 $\frac{1}{2}$	100	90	70	45	40	30	25
1 $\frac{3}{4}$	95	75	60	40	35	25	20
2	85	65	55	35	30	20	15
2 $\frac{1}{2}$	65	55	45	30	25	15	15
2 $\frac{3}{4}$	60	50	40	30	25	15	15
3	55	45	35	25	20	10	10

P—Plain. M—Metallic.

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INSULATIONS

EHRET'S ASBESTOS TUBING . . .

Asbestos tubing, also known as sleeving, is used in the electrical and chemical industries as well as in laboratory work. It is used as a covering on wires, and in glass plants, asbestos tubing is slipped over the tines or prongs of forks to prevent injury to hot glass products that are handled with these implements.

Asbestos tubing is made by braiding asbestos yarn into tubular form. It is made to exact diameter so that wire of specified gauge can be snugly fitted with an asbestos tube covering.

The following information will assist in the specification of asbestos tubing.

Wall Thicknesses—are known as Standard ($\frac{1}{16}$"), Light ($\frac{1}{32}$") and Heavy ($\frac{1}{8}$").

Diameters—of both the inside and outside of asbestos tubing are shown in the accompanying table.

Plain or Metallic—asbestos available in tubular form. Unless otherwise specified, Plain asbestos will be furnished.

Ferrous and Non-Ferrous—asbestos tubing can be furnished. Unless otherwise specified, Ferrous asbestos will be supplied.

ASBESTOS TUBING		
LIGHT WALL ($\frac{1}{32}$" Thick)		
Diameters in Inches		Approx. No. Ft. Per Lb.
Inside	Outside	
$\frac{1}{64}$	$\frac{3}{32}$	650
$\frac{1}{32}$	$\frac{3}{32}$	525
$\frac{1}{16}$	$\frac{1}{8}$	320
$\frac{3}{32}$	$\frac{5}{32}$	215
$\frac{1}{8}$	$\frac{3}{16}$	155
$\frac{5}{32}$	$\frac{7}{32}$	148
$\frac{3}{16}$	$\frac{1}{4}$	145
$\frac{7}{32}$	$\frac{9}{32}$	130
$\frac{1}{4}$	$\frac{5}{16}$	100
$\frac{9}{32}$	$\frac{11}{32}$	90
$\frac{5}{16}$	$\frac{3}{8}$	80
$\frac{3}{8}$	$\frac{7}{16}$	70
$\frac{1}{2}$	$\frac{9}{16}$	50
STANDARD WALL ($\frac{1}{16}$" Thick)		
$\frac{1}{64}$	$\frac{1}{8}$	200
$\frac{1}{32}$	$\frac{5}{32}$	150
$\frac{1}{16}$	$\frac{3}{16}$	125
$\frac{3}{32}$	$\frac{7}{32}$	100
$\frac{1}{8}$	$\frac{1}{4}$	75
$\frac{5}{32}$	$\frac{9}{32}$	70
$\frac{3}{16}$	$\frac{5}{16}$	65
$\frac{1}{4}$	$\frac{3}{8}$	55
$\frac{5}{16}$	$\frac{7}{16}$	43
$\frac{3}{8}$	$\frac{1}{2}$	23
$\frac{1}{2}$	$\frac{5}{8}$	20
$\frac{9}{16}$	$\frac{11}{16}$	17
$\frac{5}{8}$	$\frac{3}{4}$	16
$\frac{3}{4}$	$\frac{7}{8}$	14
$\frac{7}{8}$	1	12
1	$1\frac{1}{8}$	11
$1\frac{1}{8}$	$1\frac{1}{4}$	10
$1\frac{1}{4}$	$1\frac{3}{8}$	9
$1\frac{3}{8}$	$1\frac{1}{2}$	9
$1\frac{1}{2}$	$1\frac{5}{8}$	7
$1\frac{3}{4}$	$1\frac{7}{8}$	6
$1\frac{7}{8}$	2	5
2	$2\frac{1}{8}$	$4\frac{3}{4}$
$2\frac{1}{4}$	$2\frac{3}{8}$	$4\frac{1}{4}$
$2\frac{1}{2}$	$2\frac{5}{8}$	$3\frac{1}{2}$
3	$3\frac{1}{8}$	3
$3\frac{1}{2}$	$3\frac{5}{8}$	$2\frac{3}{4}$
4	$4\frac{1}{8}$	$2\frac{1}{8}$

All Grades—are available from Commercial through AAAA.

Woven Tubing—can be furnished on special order made to customers' specifications.

Packaging

Ehret's Asbestos Tubing is available on 1, 5 and 10-lb. spools as well as 25 and 50-lb. reels.

EHRET

USEFUL DATA

EHRET MAGNESIA MANUFACTURING COMPANY, VALLEY FORGE, PENNA.

Sheet No. D 700

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DEFINITIONS

of some frequently used technical terms

ABSOLUTE PRESSURE in a system is the pressure above zero pressure. It is approximately equal to the sum of the atmospheric pressure and the gauge pressure.

ABSOLUTE TEMPERATURE is temperature measured from a base of absolute zero. Absolute zero represents a condition which can be approached but not attained by lowering temperature indefinitely. On the ordinary Fahrenheit scale the absolute zero is approximately minus 460° F.

AMPERE is the practical unit of electric current. It is that amount of current which will flow through a conductor having a resistance of one ohm, under a one volt potential difference.

BAUMÉ is a scale used as a basis for hydrometer readings.

BOILER EFFICIENCY as ordinarily stated, is the efficiency of boiler furnace and grate. It is the ratio of the heat absorbed by the boiler per pound of fuel fired to the heat of perfect combustion per pound of fuel. The efficiency of the boiler alone is figured on a slightly different basis, namely as the ratio of the heat absorbed by the boiler per pound of fuel fired to the heat actually developed in the furnace per pound of fuel. This efficiency of the boiler alone is difficult to obtain with accuracy and is seldom used.

BOILER HORSEPOWER is the equivalent evaporation of 34.5 pounds of water per hour from and at 212° F. The heat output is equal to 970.3 x 34.5 which equals 33,475 BTUs per hour.

BRAKE HORSEPOWER is the actual horsepower of an engine as measured at the flywheel. It is the indicated horsepower less the friction loss of the engine.

BTU is the abbreviation for British Thermal Unit. Two definitions of the BTU are in common use, namely:

1. The BTU is the amount of heat required to raise the temperature of one pound of water from 58.5° to 59.5° F. under constant atmospheric pressure.
2. The BTU is 1/180 of the amount of heat required to raise the temperature of one pound of water from 32° to 212° F. under constant atmospheric pressure.

CALORIE has two definitions in common use, namely:

1. The Calorie is the amount of heat required to raise the temperature of one kilogram of water from 14.5° to 15.5° C. under constant atmospheric pressure.
2. The calorie is 1/100 of the amount of heat required to raise the temperature of 1 kilogram of water from 0° to 100° C. under constant atmospheric pressure. The small calorie, sometimes distinguished from the Calorie by not using the capital letter, is 1/1000 of a Calorie.

CONDUCTIVITY (see Thermal Conductivity.)

DECIBEL is a logarithmic unit for denoting the relative levels of intensity of two noises or sounds. The difference in intensity in decibels is equal to ten times the logarithm to the base 10 of the ratio of the intensities. By adopting a standard intensity as a reference level, the decibel can be used to express absolute sound levels.

DENSITY of a body is its mass per unit volume. (Usually expressed in weight per unit volume.)

DEW-POINT of the air is the temperature at which its water vapor content is sufficient to saturate it.

DRY-BULB TEMPERATURE is the air temperature as shown by an ordinary thermometer.

ELECTRIC HORSEPOWER EQUIVALENT: 746 Watts.

EMISSIVITY (Total) of a surface is the ratio of its radiant flux to that of a black body or complete radiator of the same area and at the same temperature.

FOOT POUND is a unit of mechanical work. It is the work done by a force of one pound acting through a distance of one foot. The energy in one BTU is equal to 777.8 foot pounds.

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GAUGE PRESSURE is pressure above atmospheric. Atmospheric pressure for this purpose, may be either the prevailing atmospheric pressure or a standard atmospheric pressure of 14.7 lbs./sq. in.

HORSEPOWER. (See boiler and mechanical horsepower.)

HYDROMETER is an instrument for measuring the density or specific gravity of liquids.

KINETIC ENERGY of a body is the amount of work it can do by virtue of its speed while coming to rest. Any moving body possesses kinetic energy.

KILOWATT is a unit of power, commonly used in measuring electric power.

KILOWATT HOUR is a unit of energy, commonly used in measuring energy supplied electrically. It is the energy supplied by the use of one kilowatt for one hour.

LATENT HEAT is the heat absorbed or rejected by a substance in changing its state without changing its temperature. The values for latent heat of water are:

970.3 BTU, water to steam
143.4 BTU, ice to water.

MECHANICAL HORSEPOWER is a unit of power. One horsepower is equal to 33,000 foot pounds per minute which equals 2544 BTUs per hour.

MECHANICAL EQUIVALENT OF HEAT is the number of units of energy, measured mechanically which are equivalent to one unit of energy, measured thermally. For example, approximately 777.8 foot lbs. are equivalent to 1 BTU.

POTENTIAL ENERGY of a body is the amount of work it can do by virtue of its position or configuration while changing to some standard position or configuration. Any body so held that it can do work, if released, possesses potential energy.

POTENTIOMETER is an instrument for measuring electromotive forces in terms of the electromotive force of a standard cell.

PYROMETER is an instrument for measuring high temperatures.

SPECIFIC GRAVITY is the ratio of the mass of any volume of a material at a specified temperature, to the mass of an equal volume of water at a specified temperature. The specific gravity of a gas may also be expressed as the ratio of the mass of any volume of the gas, to the mass of an equal volume of oxygen or hydrogen or air, at the same temperature and pressure as the gas.

SPECIFIC HEAT of a substance is expressed as the number of units of energy required to raise the temperature of unit mass of the substance through 1°, under specified conditions, such as constant pressure, constant volume, etc.

STEAM is the term generally applied to water vapor at 212, or more, degrees F. If the steam is in equilibrium with water at the same temperature it is said to be saturated, and its temperature depends only on its pressure. If the temperature of the steam is higher than that corresponding to the temperature of saturated steam at the same pressure, the steam is said to be super-heated, if lower, it is said to be supersaturated.

THERMAL CONDUCTIVITY of a material is expressed as the amount of heat transmitted through a unit area of the material in unit time, with a temperature gradient of 1° per unit thickness. The expression of thermal conductivity is frequently based on BTUs per square foot of surface, per inch of thickness, per hour, per degree F. of temperture difference.

VOLT is the unit of electric potential difference, or electromotive force.

WATT is a unit of power, commonly used in measuring electric power. When a current of one ampere flows through a system in which the potential drop is one volt, the power supplied to the system is one watt.

WET-BULB TEMPERATURE is that temperature shown by a thermometer that has its bulb encased in a wet wick. The temperature shown depends upon the speed of the air moving past the wick-covered bulb, and the standard for a ventilated psychrometer is an air speed above 10 ft. per second. This type of thermometer, in conjunction with a dry-bulb thermometer, is used in determining relative humidity.

Heat Losses from Horizontal Bare Iron Surfaces

In BTUs per sq. ft. of metal surface per hour per °F. temp. diff. between metal and air

Pipe Size Inches	TEMPERATURE DIFFERENCE BETWEEN METAL AND AIR IN DEGREES F.												
	50°	100°	200°	300°	400°	500°	600°	700°	800°	900°	1000°	1100°	1200°
½	2.48	2.70	3.21	3.84	4.57	5.41	6.31	7.25	8.22	9.23	10.20	11.20	12.20
¾	2.36	2.57	3.07	3.68	4.42	5.25	6.15	7.09	8.06	9.07	10.04	11.04	12.04
1	2.29	2.50	3.00	3.60	4.34	5.16	6.05	6.98	7.95	8.96	9.93	10.94	11.93
1¼	2.24	2.45	2.94	3.54	4.28	5.09	5.98	6.91	7.88	8.89	9.86	10.87	11.86
1½	2.20	2.41	2.90	3.50	4.23	5.03	5.92	6.86	7.83	8.84	9.81	10.82	11.81
2	2.15	2.35	2.85	3.45	4.16	4.98	5.84	6.77	7.74	8.76	9.73	10.72	11.73
2½	2.09	2.29	2.78	3.37	4.09	4.91	5.78	6.71	7.68	8.71	9.69	10.68	11.69
3	2.05	2.25	2.73	3.31	4.03	4.85	5.71	6.66	7.63	8.66	9.63	10.62	11.63
3½	2.02	2.22	2.69	3.27	3.98	4.80	5.67	6.62	7.59	8.62	9.59	10.58	11.59
4	2.00	2.19	2.66	3.24	3.95	4.77	5.64	6.58	7.55	8.58	9.55	10.54	11.55
4½	1.98	2.17	2.63	3.22	3.92	4.74	5.62	6.54	7.53	8.55	9.52	10.51	11.52
5	1.97	2.15	2.61	3.20	3.90	4.71	5.60	6.52	7.49	8.52	9.49	10.48	11.49
6	1.95	2.13	2.59	3.18	3.89	4.69	5.57	6.49	7.46	8.49	9.46	10.45	11.46
7	1.93	2.11	2.57	3.16	3.87	4.67	5.55	6.47	7.44	8.47	9.44	10.43	11.44
8	1.91	2.09	2.56	3.14	3.86	4.66	5.53	6.46	7.43	8.45	9.42	10.41	11.42
9	1.90	2.08	2.55	3.13	3.85	4.65	5.51	6.45	7.42	8.43	9.40	10.39	11.40
10	1.89	2.07	2.54	3.12	3.84	4.64	5.50	6.44	7.41	8.41	9.38	10.37	11.38
12	1.87	2.05	2.52	3.10	3.81	4.61	5.48	6.41	7.38	8.39	9.36	10.35	11.36
14	1.86	2.04	2.50	3.08	3.79	4.59	5.46	6.39	7.36	8.37	9.34	10.33	11.34
16	1.85	2.03	2.48	3.06	3.77	4.57	5.44	6.37	7.34	8.35	9.32	10.31	11.32
18	1.84	2.02	2.47	3.05	3.75	4.55	5.42	6.35	7.32	8.33	9.30	10.29	11.30
Flat	1.75	1.92	2.35	2.90	3.56	4.32	5.15	6.04	6.95	7.95	8.85	9.75	10.70

Note:—To translate heat losses to terms of BTUs per lineal foot per hour, multiply the above figures by the temperature difference and then by the number of square feet per lineal foot of pipe as given on Sheet No. 703.

Thermal Expansion of Pipes

In inches per 100 lineal feet

Temperature Degrees Fahrenheit	Cast Iron Pipe	Steel Pipe	Wrought Iron Pipe	Copper Pipe	Temperature Degrees Fahrenheit	Cast Iron Pipe	Steel Pipe	Wrought Iron Pipe	Copper Pipe
—20	0	0	0	0	500	3.847	4.296	4.477	6.110
0	0.127	0.145	0.152	0.204	520	4.020	4.487	4.677	6.352
20	0.255	0.293	0.306	0.442	540	4.190	4.670	4.866	6.614
40	0.390	0.430	0.465	0.655	560	4.365	4.860	5.057	6.850
60	0.518	0.593	0.620	0.888	580	4.541	5.051	5.268	7.123
80	0.649	0.725	0.780	1.100	600	4.725	5.247	5.455	7.388
100	0.787	0.898	0.939	1.338	620	4.896	5.437	5.660	7.636
120	0.926	1.055	1.110	1.570	640	5.082	5.627	5.850	7.893
140	1.051	1.209	1.265	1.794	660	5.260	5.831	6.067	8.153
160	1.200	1.368	1.427	2.008	680	5.442	6.020	6.260	8.400
180	1.345	1.528	1.597	2.255	700	5.629	6.229	6.481	8.676
200	1.495	1.691	1.778	2.500	720	5.808	6.425	6.673	8.912
220	1.634	1.852	1.936	2.720	740	6.006	6.635	6.899	9.203
240	1.780	2.020	2.110	2.960	760	6.200	6.833	7.100	9.460
260	1.931	2.183	2.279	3.189	780	6.389	7.046	7.314	9.736
280	2.085	2.350	2.465	3.422	800	6.587	7.250	7.508	9.992
300	2.233	2.519	2.630	3.665	820	6.779	7.464	7.757	10.272
320	2.395	2.690	2.800	3.900	840	6.970	7.662	7.952	10.512
340	2.543	2.862	2.988	4.145	860	7.176	7.888	8.195	10.814
360	2.700	3.029	3.175	4.380	880	7.375	8.098	8.400	11.175
380	2.859	3.211	3.350	4.628	900	7.579	8.313	8.639	11.360
400	3.008	3.375	3.521	4.870	920	7.795	8.545	8.867	11.625
420	3.182	3.566	3.720	5.118	940	7.989	8.755	9.089	11.911
440	3.345	3.740	3.900	5.358	960	8.200	8.975	9.300	12.180
460	3.511	3.929	4.096	5.612	980	8.406	9.196	9.547	12.473
480	3.683	4.100	4.280	5.855	1000	8.617	9.421	9.776	12.747

To obtain the amount of expansion between any two temperatures, take the proportionate difference between the values given for those temperatures.

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EHRET INSULATIONS

Heat Losses from Horizontal Bare Copper Pipe

In BTUs per lineal foot per hour

Pipe Size	Actual O. D.	Lineal Foot Factor	TEMPERATURE DIFFERENCE—PIPE TO AIR													
			50		100		150		200		250		300		350	
			B	T	B	T	B	T	B	T	B	T	B	T	B	T
½	0.840	.220	11.4	14.0	27.0	38.0	45.5	64.0	65.0	94.0	87.5	129	112	167	141	212
¾	1.050	.275	13.7	19.4	32.5	46.5	54.0	78.0	78.0	114	104	159	135	204	169	257
1	1.315	.344	16.4	23.8	38.5	56.0	64.0	95.5	95.0	140	125	194	163	250	205	316
1¼	1.660	.435	20.4	29.3	47.5	68.5	79.0	117	115	174	154	238	198	308	250	384
1½	1.900	.498	22.3	32.4	53.0	78.0	88.0	131	127	194	170	269	221	346	279	438
2	2.375	.622	26.8	40.0	63.0	94.0	106	160	152	236	204	329	265	425	335	540
2½	2.875	.753	31.3	47.2	74.0	113	121	188	177	278	238	385	310	500	394	633
3	3.500	.917	36.7	56.0	87.2	133	144	225	209	330	280	460	364	595	460	765
3½	4.000	1.0417	41.0	63.0	96.5	148	162	252	234	370	311	520	408	672	520	855
4	4.500	1.179	45.4	70.0	107	166	177	280	258	415	345	580	450	750	573	950
4½	5.000	1.310	49.0	77.0	118	183	195	308	280	452	375	638	490	835	630	1045
5	5.563	1.458	53.5	85.5	127	200	214	340	306	505	412	704	540	910	690	1160
6	6.625	1.736	62.2	100	147	235	244	396	354	585	475	820	623	1070	795	1360

Heat Losses from Horizontal Bare Copper Water Tubing

In BTUs per lineal foot per hour

Pipe Size	Actual O. D.	Lineal Foot Factor	TEMPERATURE DIFFERENCE—PIPE TO AIR													
			50		100		150		200		250		300		350	
			B	T	B	T	B	T	B	T	B	T	B	T	B	T
½	.625	.164	8.9	12.4	21.4	29.6	35.4	50.5	51.0	73.0	68.0	103	88.0	129	110	163
¾	.875	.229	11.8	16.7	28.0	39.4	47.0	66.5	67.0	97.0	90.0	136	116	173	145	219
1	1.125	.293	14.4	20.4	34.4	49.0	57.0	83.0	83.0	122	109	168	142	215	177	271
1¼	1.375	.360	17.0	24.8	40.5	58.5	67.0	99.0	98.0	144	128	208	167	258	214	326
1½	1.625	.426	19.5	28.8	46.5	67.5	78.0	115	112	148	149	234	193	300	244	380
2	2.125	.556	24.4	35.5	58.0	85.0	96.0	144	138	215	186	298	244	380	304	483
2½	2.625	.687	29.0	43.5	68.7	103	115	174	164	258	221	358	286	458	364	582
3	3.125	.818	33.2	50.5	78.0	118	133	203	188	298	256	417	330	535	420	680
3½	3.625	.949	37.8	57.5	89.0	137	148	232	214	340	291	475	374	610	475	780
4	4.125	1.079	41.8	65.0	99.0	153	166	259	240	385	320	535	415	688	535	870
5	5.125	1.341	50.5	79.0	119	188	200	316	286	465	388	655	505	845	650	1080
6	6.125	1.603	58.0	92.5	138	218	232	370	335	545	445	765	585	990	750	1280

B—Bright surface. T—Tarnished surface.

Heat Losses from Canvas Surfaces

In BTUs per square foot per hour

Canvas Temperature Difference	Flat Surface Per Square Foot	OUTSIDE DIAMETER OF INSULATION ON PIPE									
		3	4	5	6	8	10	12	14	16	18
20	24	37	35	33	31	30	29	28	27	26	25
30	37	58	55	52	49	47	45	43	42	41	40
40	52	80	76	72	69	66	64	62	60	58	56
50	67	105	100	95	90	86	82	79	77	75	73
60	84	131	124	118	113	108	104	101	98	96	94
70	103	160	152	145	138	132	126	122	119	116	114
80	123	190	182	174	166	158	151	146	142	138	135
90	145	225	215	206	197	188	179	172	167	163	160
100	171	265	253	242	232	222	213	205	198	192	187
110	201	310	296	283	271	259	247	238	231	225	220
120	232	360	344	329	314	300	286	276	268	261	256
130	269	418	400	382	365	348	332	320	311	303	296

Heat Losses from Canvas Surfaces

In BTUs per lineal foot of pipe per hour

Canvas Temperature Difference	Flat Surface Per Square Foot	OUTSIDE DIAMETER OF INSULATION ON PIPE									
		3	4	5	6	8	10	12	14	16	18
20	24	29	36	43	49	63	76	88	99	109	118
30	37	45	58	68	77	98	118	135	154	172	188
40	52	63	80	94	108	138	167	195	220	243	264
50	67	82	105	125	141	180	215	248	282	314	344
60	84	103	131	155	177	226	272	317	359	402	443
70	103	125	160	190	217	276	330	383	436	486	537
80	123	149	190	230	260	331	395	459	520	578	636
90	145	177	225	270	310	394	469	540	612	683	754
100	171	209	268	318	365	465	558	644	726	804	881
110	201	245	310	370	426	542	647	718	847	942	1037
120	232	284	365	430	493	628	749	867	982	1093	1206
130	269	328	421	500	573	729	869	1005	1140	1269	1395

The canvas temperature difference is obtained by subtracting the room temperature from the actual temperature of the insulation surface.

Note:—The figures in the above tables were computed on a basis of average canvas surfaces under still air conditions, and consequently should be considered as approximations.

Printed in U. S. A. 9-38

EHRET INSULATIONS

Comparative Thermal Values of Various Fuels

Based on their respective units of weight or volume

		Natural Gas 1,000 BTU/cu. ft.	Artificial Gas 550 BTU/cu. ft.	Blast Furnace Gas 100 BTU/cu. ft.	Producer Gas 150 BTU/cu. ft.	Coke Breeze 10,000 BTU/Lb.	Coke 12,000 BTU/Lb.	Coal 12,500 BTU/Lb.	Coal 13,000 BTU/Lb.	Coal 13,500 BTU/Lb.	Coal 14,000 BTU/Lb.	Fuel Oil 140,000 BTU/Gal.	Fuel Oil 145,000 BTU/Gal.	Fuel Oil 150,000 BTU/Gal.	Electric Current 3,412 BTU/KW.
1,000 cu. ft.	Natural Gas 1,000 BTU/cu. ft.		1,818 cu. ft.	10,000 cu. ft.	6,667 cu. ft.	100 Lbs.	83.4 Lbs.	80 Lbs.	77 Lbs.	74 Lbs.	71.5 Lbs.	7.15 Gals.	6.9 Gals.	6.67 Gals.	293 KW.
	Artificial Gas 550 BTU/cu. ft.	550 cu. ft.		5,500 cu. ft.	3,670 cu. ft.	55 Lbs.	45.8 Lbs.	44 Lbs.	42.3 Lbs.	40.7 Lbs.	39.3 Lbs.	3.93 Gals.	3.8 Gals.	3.67 Gals.	161 KW.
	Blast Furnace Gas 100 BTU/cu. ft.	100 cu. ft.	181.8 cu. ft.		667 cu. ft.	10 Lbs.	8.34 Lbs.	8 Lbs.	7.7 Lbs.	7.4 Lbs.	7.15 Lbs.	.715 Gals.	.69 Gals.	.667 Gals.	29.3 KW.
	Producer Gas 150 BTU/cu. ft.	150 cu. ft.	273 cu. ft.	1,500 cu. ft.		15 Lbs.	12.5 Lbs.	12 Lbs.	11.55 Lbs.	11.10 Lbs.	10.70 Lbs.	1.07 Gals.	1.03 Gals.	1.00 Gals.	44 KW.
2,000 Pounds	Coke Breeze 10,000 BTU/Lb.	20,000 cu. ft.	36,400 cu. ft.	200,000 cu. ft.	133,500 cu. ft.		1,667 Lbs.	1,600 Lbs.	1,540 Lbs.	1,480 Lbs.	1,430 Lbs	143 Gals.	138 Gals.	133 Gals.	5,862 KW.
	Coke 12,000 BTU/Lb.	24,000 cu. ft.	43,700 cu. ft.	240,000 cu. ft.	160,000 cu. ft.	2,400 Lbs.		1,920 Lbs.	1,845 Lbs.	1,780 Lbs.	1,712 Lbs.	171 Gals.	166 Gals.	160 Gals.	7,031 KW.
	Coal 12,500 BTU/Lb.	25,000 cu. ft.	45,500 cu. ft.	250,000 cu. ft.	166,500 cu. ft.	2,500 Lbs.	2,080 Lbs.		1,925 Lbs.	1,850 Lbs.	1,785 Lbs.	178 Gals.	172 Gals.	167 Gals.	7,327 KW.
	Coal 13,000 BTU/Lb.	26,000 cu. ft.	47,300 cu. ft.	260,000 cu. ft.	173,200 cu. ft.	2,600 Lbs.	2,162 Lbs.	2,080 Lbs.		1,925 Lbs.	1,857 Lbs.	185 Gals.	179 Gals.	173 Gals.	7,618 KW.
	Coal 13,500 BTU/Lb.	27,000 cu. ft.	49,100 cu. ft.	270,000 cu. ft.	179,800 cu. ft.	2,700 Lbs.	2,250 Lbs.	2,160 Lbs.	2,075 Lbs.		1,930 Lbs.	193 Gals.	186 Gals.	180 Gals.	7,911 KW.
	Coal 14,000 BTU/Lb.	28,000 cu. ft.	50,800 cu. ft.	280,000 cu. ft.	186,500 cu. ft.	2,800 Lbs.	2,335 Lbs.	2,240 Lbs.	2,156 Lbs.	2,075 Lbs.		200 Gals.	193 Gals.	187 Gals.	8,206 KW.
One Gallon	Fuel Oil 140,000 BTU/Gal.	140 cu. ft.	255 cu. ft.	1,400 cu. ft.	934 cu. ft.	14 Lbs.	11.7 Lbs.	11.2 Lbs.	10.78 Lbs.	10.38 Lbs.	10 Lbs.		.966 Gals.	.934 Gals.	41 KW.
	Fuel Oil 145,000 BTU/Gal.	145 cu. ft.	264 cu. ft.	1,450 cu. ft.	966 cu. ft.	14.5 Lbs.	12.09 Lbs.	11.6 Lbs.	11.15 Lbs.	10.72 Lbs.	10.35 Lbs.	1.03 Gals.		.966 Gals.	42.5 KW.
	Fuel Oil 150,000 BTU/Gal.	150 cu. ft.	273 cu. ft.	1,500 cu. ft.	1,000 cu. ft.	15 Lbs.	12.5 Lbs.	12 Lbs.	11.5 Lbs.	11.1 Lbs.	10.7 Lbs.	1.07 Gals.	1.032 Gals.		44 KW.
One KW.	Electric Current 3,412 BTU/KW.	3,412 cu. ft.	6.2 cu. ft.	34 cu. ft.	22.7 cu. ft.	.3412 Lbs.	.284 Lbs.	.273 Lbs.	.262 Lbs.	.252 Lbs.	.244 Lbs.	.0244 Gals.	.0235 Gals.	.0227 Gals.	

Example:—One gallon of 140,000 BTU Fuel Oil is equivalent to 10 lbs. of 14,000 BTU Coal.

Effect of Wind Velocity on Bare or Insulated Surfaces

Ratio of heat loss to still air conditions

Wind Velocity Miles per Hour	TEMPERATURE DIFFERENCE BETWEEN EXPOSED SURFACE AND AIR IN DEG. F.								
	100	200	300	400	500	600	700	800	900
2½	1.46	1.43	1.40	1.36	1.32	1.27	1.22	1.17	1.12
5	1.74	1.69	1.64	1.59	1.53	1.47	1.38	1.29	1.20
10	2.16	2.10	2.02	1.93	1.84	1.72	1.59	1.45	1.31
15	2.50	2.42	2.33	2.21	2.08	1.94	1.77	1.60	1.44
20	2.76	2.69	2.58	2.45	2.30	2.14	1.94	1.75	1.54
25	2.98	2.89	2.78	2.64	2.49	2.30	2.10	1.90	1.65
30	3.15	3.06	2.94	2.81	2.66	2.46	2.25	2.02	1.77
35	3.30	3.21	3.10	2.97	2.81	2.61	2.40	2.15	1.90

The figures in this table are conservative. Some authorities report ratios considerably larger than those shown here.

STANDARD PIPE DATA

All Dimensions and Weights are Nominal

Size Ins.	Diameters		Thick-ness Inches	Circumference		Transverse Areas			External Surface Area in Sq. Ft. Per Lineal Ft. of Pipe	Length of Pipe Con-taining One Cubic Foot Feet	Weight per Foot		Wt. of Water Per Foot Pounds
	External Inches	Internal Inches		External Inches	Internal Inches	External Sq. Ins.	Internal Sq. Ins.	Metal Sq. Ins.			Plain Ends Pounds	Threaded and Coupled Pounds	
⅛	.405	.269	.068	1.272	.845	.129	.057	.072	.1060	2533.775	.244	.245	.025
¼	.540	.364	.088	1.696	1.144	.229	.104	.125	.1414	1383.789	.424	.425	.045
⅜	.675	.493	.091	2.121	1.549	.358	.191	.167	.1767	754.360	.567	.568	.083
½	.840	.622	.109	2.639	1.954	.554	.304	.250	.220	473.906	.850	.852	.132
¾	1.050	.824	.113	3.299	2.589	.866	.533	.333	.275	270.034	1.130	1.134	.231
1	1.315	1.049	.133	4.131	3.296	1.358	.864	.494	.344	166.618	1.678	1.684	.375
1¼	1.660	1.380	.140	5.215	4.335	2.164	1.495	.669	.435	96.275	2.272	2.281	.65
1½	1.900	1.610	.145	5.969	5.058	2.835	2.036	.799	.498	70.733	2.717	2.731	.88
2	2.375	2.067	.154	7.461	6.494	4.430	3.355	1.075	.622	42.913	3.652	3.678	1.45
2½	2.875	2.469	.203	9.032	7.757	6.492	4.788	1.704	.753	30.077	5.793	5.819	2.07
3	3.500	3.068	.216	10.996	9.638	9.621	7.393	2.228	.917	19.479	7.575	7.616	3.20
3½	4.000	3.548	.226	12.566	11.146	12.566	9.886	2.680	1.047	14.565	9.109	9.202	4.29
4	4.500	4.026	.237	14.137	12.648	15.904	12.730	3.174	1.179	11.312	10.790	10.889	5.50
4½	5.000	4.506	.247	15.708	14.156	19.635	15.947	3.688	1.310	9.030	12.538	12.642	6.91
5	5.563	5.047	.258	17.477	15.856	24.306	20.006	4.300	1.458	7.198	14.617	14.810	8.67
6	6.625	6.065	.280	20.813	19.054	34.472	28.891	5.581	1.736	4.984	18.974	19.185	12.51
7	7.625	7.023	.301	23.955	22.063	45.664	38.738	6.926	2.000	3.717	23.544	23.769	16.80
8	8.625	8.071	.277	27.096	25.356	58.426	51.161	7.265	2.262	2.815	24.696	25.000	22.18
8	8.625	7.981	.322	27.096	25.073	58.426	50.027	8.399	2.262	2.878	28.554	28.809	21.70
9	9.625	8.941	.342	30.238	28.089	72.760	62.786	9.974	2.525	2.294	33.907	34.188	27.20
10	10.750	10.192	.279	33.772	32.019	90.763	81.585	9.178	2.817	1.765	31.201	32.000	35.37
10	10.750	10.136	.307	33.772	31.843	90.763	80.691	10.072	2.817	1.785	34.240	35.000	34.95
10	10.750	10.020	.365	33.772	31.479	90.763	78.855	11.908	2.817	1.826	40.483	41.132	34.20
11	11.750	11.000	.375	36.914	34.558	108.434	95.033	13.401	3.075	1.515	45.557	46.247	41.20
12	12.750	12.090	.330	40.055	37.982	127.676	114.800	12.876	3.344	1.254	43.773	45.000	49.70
12	12.750	12.000	.375	40.055	37.699	127.676	113.097	14.579	3.344	1.273	49.562	50.706	49.00

EXTRA STRONG PIPE DATA

All Dimensions and Weights are Nominal

Size Ins.	Diameters		Thick-ness Inches	Circumference		Transverse Areas			External Surface Area in Sq. Ft. Per Lineal Ft. of Pipe	Length of Pipe Con-taining One Cubic Foot Feet	Weight per Foot Plain Ends Pounds	Wt. of Water Per Foot Pounds
	External Inches	Internal Inches		External Inches	Internal Inches	External Sq. Ins.	Internal Sq. Ins.	Metal Sq. Ins.				
⅛	.405	.215	.095	1.272	.675	.129	.036	.093	.1060	3966.392	.314	.016
¼	.540	.302	.119	1.696	.949	.229	.072	.157	.1414	2010.290	.535	.031
⅜	.675	.423	.126	2.121	1.329	.358	.141	.217	.1767	1024.689	.738	.061
½	.840	.546	.147	2.639	1.715	.554	.234	.320	.220	615.017	1.087	.102
¾	1.050	.742	.154	3.299	2.331	.866	.433	.433	.275	333.016	1.473	.188
1	1.315	.957	.179	4.131	3.007	1.358	.719	.639	.344	200.193	2.171	.312
1¼	1.660	1.278	.191	5.215	4.015	2.164	1.283	.881	.435	112.256	2.996	.56
1½	1.900	1.500	.200	5.969	4.712	2.835	1.767	1.068	.498	81.487	3.631	.77
2	2.375	1.939	.218	7.461	6.092	4.430	2.953	1.477	.622	48.766	5.022	1.28
2½	2.875	2.323	.276	9.032	7.298	6.492	4.238	2.254	.753	33.976	7.661	1.87
3	3.500	2.900	.300	10.996	9.111	9.621	6.605	3.016	.917	21.801	10.252	2.86
3½	4.000	3.364	.318	12.566	10.568	12.566	8.888	3.678	1.047	16.202	12.505	3.84
4	4.500	3.826	.337	14.137	12.020	15.904	11.497	4.407	1.179	12.525	14.983	4.98
4½	5.000	4.290	.355	15.708	13.477	19.635	14.455	5.180	1.310	9.962	17.611	6.27
5	5.563	4.813	.375	17.477	15.120	24.306	18.194	6.112	1.458	7.915	20.778	7.88
6	6.625	5.761	.432	20.813	18.099	34.472	26.067	8.405	1.736	5.524	28.573	11.29
7	7.625	6.625	.500	23.955	20.813	45.664	34.472	11.192	2.000	4.177	38.048	14.95
8	8.625	7.625	.500	27.096	23.955	58.426	45.663	12.763	2.262	3.154	43.388	19.78
9	9.625	8.625	.500	30.238	27.096	72.760	58.426	14.334	2.525	2.464	48.728	25.30
10	10.750	9.750	.500	33.772	30.631	90.763	74.662	16.101	2.817	1.929	54.735	32.35
11	11.750	10.750	.500	36.914	33.772	108.434	90.763	17.671	3.075	1.587	60.075	39.40
12	12.750	11.750	.500	40.055	36.914	127.676	108.434	19.242	3.344	1.328	65.415	46.92

DOUBLE EXTRA STRONG PIPE DATA

All Dimensions and Weights are Nominal

Size Ins.	Diameters		Thick-ness Inches	Circumference		Transverse Areas			External Surface Area in Sq. Ft. Per Lineal Ft. of Pipe	Length of Pipe Containing One Cubic Foot Feet	Weight per Foot Plain Ends Pounds	Wt. of Water Per Foot Pounds
	External Inches	Internal Inches		External Inches	Internal Inches	External Sq. Ins.	Internal Sq. Ins.	Metal Sq. Ins.				
½	.840	.252	.294	2.639	.792	.554	.050	.504	.220	2887.164	1.714	.022
¾	1.050	.434	.308	3.299	1.363	.866	.148	.718	.275	973.404	2.440	.064
1	1.315	.599	.358	4.131	1.882	1.358	.282	1.076	.344	510.998	3.659	.122
1¼	1.660	.896	.382	5.215	2.815	2.164	.630	1.534	.435	228.379	5.214	.273
1½	1.900	1.100	.400	5.969	3.456	2.835	.950	1.885	.498	151.526	6.408	.42
2	2.375	1.503	.436	7.461	4.722	4.430	1.774	2.656	.622	81.162	9.029	.77
2½	2.875	1.771	.552	9.032	5.564	6.492	2.464	4.028	.753	58.457	13.695	1.07
3	3.500	2.300	.600	10.996	7.226	9.621	4.155	5.466	.917	34.659	18.583	1.80
3½	4.000	2.728	.636	12.566	8.570	12.566	5.845	6.721	1.047	24.637	22.850	2.53
4	4.500	3.152	.674	14.137	9.902	15.904	7.803	8.101	1.179	18.454	27.541	3.38
4½	5.000	3.580	.710	15.708	11.247	19.635	10.066	9.569	1.310	14.306	32.530	4.36
5	5.563	4.063	.750	17.477	12.764	24.306	12.966	11.340	1.458	11.107	38.552	5.61
6	6.625	4.897	.864	20.813	15.384	34.472	18.835	15.637	1.736	7.646	53.160	8.16
7	7.625	5.875	.875	23.955	18.457	45.664	27.109	18.555	2.000	5.312	63.079	11.75
8	8.625	6.875	.875	27.096	21.598	58.426	37.122	21.304	2.262	3.879	72.424	16.10

This pipe data furnished by the Crane Co.

Printed in U. S. A. 9-38

EHRET
INSULATIONS

Process Temperatures

IRON AND STEEL MANUFACTURING

Open Hearth	2750—3150	degrees Fahrenheit
Pipe Welding:		
Butt	2350—2650	" "
Lap	1750—2650	" "
Bolt Heading	2150—2350	" "
Ingot Heating	1950—2250	" "
Slab Heating	1950—2250	" "
Spike Heating	1950—2250	" "
Bar and Shape	1900—2250	" "
Sheet Mill	1950—2150	" "
Flanging	1800—2150	" "
Rod Mill	1900—2150	" "
Soaking Pits	1900—2150	" "
Sheet Furnaces	1800—2150	" "
Blooming Mills	1900—2100	" "
Annealing:		
Sheet	1400—1650	" "

IRON AND STEEL PRODUCTS

Welding	2150—2850	degrees Fahrenheit
Drop Forging	2200—2400	" "
Hardening:		
High Speed Steel	1800—2300	" "
Steel Tools	1400—2250	" "
Cyanide	1400—1850	" "
Rivet Heating	2000—2300	" "
Heat Treating	800—1700	" "
Carbonizing	1350—1700	" "
Annealing:		
Springs	1500—1700	" "
High Carbon Steel	1400—1550	" "
Malleable Castings	1500—1750	" "
Steel Castings	1300—1650	" "
Galvanizing:		
Nail	800— 950	" "
Pipe	800— 950	" "
Sheet	800— 950	" "

IRON AND STEEL PRODUCTS—Continued

Wire	800— 950	degrees Fahrenheit
Tempering	400— 700	" "
Foundry Core Ovens	350— 650	" "

NON-FERROUS METAL PROCESSES

Melting Monel Metal	2800	degrees Fahrenheit
Melting Nickel	2650	" "
Refining Copper	2100—2650	" "
Melting Bronze	1800—2350	" "
Melting Brass	1650—2300	" "
Annealing Monel Metal	1100—1480	" "
Annealing Nickel	1100—1480	" "
Melting Aluminum	1217	" "
Annealing Brass	475—1050	" "
Annealing Copper	450— 950	" "
Annealing Aluminum	390— 850	" "
Melting Babbitt	600— 850	" "
Melting Lead	620	" "
Melting Solder	400	" "

OTHER MANUFACTURING PROCESSES

Cement Kilns	2750—3000	degrees Fahrenheit
Glass Making	2550—3000	" "
Porcelain Burning	2600	" "
Brick Burning	2450—2850	" "
China Glazing	1500—1950	" "
Vitreous Enameling	1400—1850	" "
Pigment Calcining	1650	" "
Annealing Glass	650—1550	" "
Roasting Coffee	550— 700	" "
Varnish Making	550	" "
Pie Baking	500	" "
Bread Baking	500	" "
Asphalt Melting	350— 450	" "
Japanning Ovens	300— 450	" "
Enameling Ovens	250— 450	" "
Lithographing	300	" "

Wire and Sheet Metal Gauges

Dimensions in decimal parts of an inch

Number of Wire Gauge	American or Brown & Sharpe	Birmingham or Stubs' Iron Wire	Roebling's and Washburn & Moen's	British Imperial Standard Wire Gauge	Stubs' Steel Wire	U. S. Standard for Plate	Washburn & Moen Music Wire
00000000	.....	.....	.....	.....	.....	.....	.0083
0000000	.....	.....	.4900	.5000	.....	.5000	.0087
000000	.....	.....	.4600	.4640	.....	.4687	.0095
00000	.....	.....	.4300	.4320	.....	.4375	.0100
0000	.4600	.454	.3938	.4000	.....	.4062	.0110
000	.4096	.425	.3625	.3720	.....	.3750	.0120
00	.3648	.380	.3310	.3480	.....	.3437	.0133
0	.3249	.340	.3065	.3240	.....	.3125	.0144
1	.2893	.300	.2830	.3000	.227	.2812	.0156
2	.2576	.284	.2625	.2760	.219	.2656	.0166
3	.2294	.259	.2437	.2520	.212	.2500	.0178
4	.2043	.238	.2253	.2320	.207	.2344	.0188
5	.1819	.220	.2070	.2120	.204	.2187	.0202
6	.1620	.203	.1920	.1920	.201	.2031	.0215
7	.1443	.180	.1770	.1760	.199	.1875	.0230
8	.1285	.165	.1620	.1600	.197	.1719	.0243
9	.1144	.148	.1483	.1440	.194	.1562	.0256
10	.1019	.134	.1350	.1280	.191	.1406	.0270
11	.0907	.120	.1205	.1160	.188	.1250	.0284
12	.0808	.109	.1055	.1040	.185	.1094	.0296
13	.0720	.095	.0915	.0920	.182	.0937	.0314
14	.0641	.083	.0800	.0800	.180	.0781	.0326
15	.0571	.072	.0720	.0720	.178	.0703	.0345
16	.0508	.065	.0625	.0640	.175	.0625	.0360
17	.0453	.058	.0540	.0560	.172	.0562	.0377
18	.0403	.049	.0475	.0480	.168	.0500	.0395
19	.0360	.042	.0410	.0400	.164	.0437	.0414
20	.0320	.035	.0348	.0360	.161	.0375	.0434
21	.0285	.032	.0317	.0320	.157	.0344	.0460
22	.0253	.028	.0286	.0280	.155	.0312	.0483
23	.0226	.025	.0258	.0240	.153	.0281	.0515
24	.0201	.022	.0230	.0220	.151	.0250	.0550
25	.0179	.020	.0204	.0200	.148	.0219	.0586
26	.0159	.018	.0181	.0180	.146	.0187	.0626
27	.0142	.016	.0173	.0164	.143	.0172	.0658
28	.0126	.014	.0162	.0149	.139	.0156	.0720
29	.0113	.013	.0150	.0136	.134	.0141	.0760
30	.0100	.012	.0140	.0124	.127	.0125	.0800
31	.0089	.010	.0132	.0116	.120	.0109	.....
32	.0079	.009	.0128	.0108	.115	.0102	.....
33	.0071	.008	.0118	.0100	.112	.0094	.....
34	.0063	.007	.0104	.0092	.110	.0086	.....
35	.0056	.005	.0095	.0084	.108	.0078	.....
36	.0050	.004	.0090	.0076	.106	.0070	.....
37	.0044	.....	.....	.0068	.103	.0066	.....
38	.0040	.....	.....	.0060	.101	.0062	.....
39	.0035	.....	.....	.0052	.099	.....	.....
40	.0031	.....	.....	.0048	.097	.....	.....

Saturated Steam Table

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Gauge Pressure in Lbs./Sq. In.	Absolute Pressure in Lbs./Sq. In.	Temp. in Degrees Fahr.	Spec. Vol. of Sat. Vap. in Cu. Ft./Lb.	Latent Heat of Evap. in BTUs./Lb.	Total Heat of Steam in BTUs./Lb.	Gauge Pressure in Lbs./Sq. In.	Absolute Pressure in Lbs./Sq. In.	Temp. in Degrees Fahr.	Spec. Vol. of Sat. Vap. in Cu. Ft./Lb.	Latent Heat of Evap. in BTUs /Lb.	Total Heat of Steam in BTUs./Lb.
(These pressures indicated to nearest tenth of a pound. Authors tables do not include gauge pressures.)	1	101.74	333.6	1036.3	1106.0	175.3	190	377.51	2.404	846.8	1197.6
	2	126.08	173.73	1022.2	1116.2	185.3	200	381.79	2.288	843.0	1198.4
	3	141.48	118.71	1013.2	1122.6	195.3	210	385.90	2.183	839.2	1199.0
	4	152.97	90.63	1006.4	1127.3	205.3	220	389.86	2.087	835.6	1199.6
	5	162.24	73.52	1001.0	1131.1	215.3	230	393.68	1.9992	832.0	1200.1
	6	170.06	61.98	996.2	1134.2	225.3	240	397.37	1.9183	828.5	1200.6
	7	176.85	53.64	992.1	1136.9	235.3	250	400.95	1.8438	825.1	1201.1
	8	182.86	47.34	988.5	1139.3	245.3	260	404.42	1.7748	821.8	1201.5
	9	188.28	42.40	985.2	1141.4	255.3	270	407.78	1.7107	818.5	1201.9
	10	193.21	38.42	982.1	1143.3	265.3	280	411.05	1.6511	815.3	1202.3
	12	201.96	32.40	976.6	1146.6	275.3	290	414.23	1.5954	812.1	1202.6
	14	209.56	28.04	971.9	1149.5	285.3	300	417.33	1.5433	809.0	1202.8
.0	14.696	212.00	26.80	970.3	1150.4	305.3	320	423.29	1.4485	803.0	1203.4
.3	15	213.03	26.29	969.7	1150.8	325.3	340	428.97	1.3645	797.1	1203.7
5.3	20	227.96	20.089	960.1	1156.3	345.3	360	434.40	1.2895	791.4	1204.1
10.3	25	240.07	16.303	952.1	1160.6	365.3	380	439.60	1.2222	785.8	1204.3
15.3	30	250.33	13.746	945.3	1164.1	385.3	400	444.59	1.1613	780.5	1204.5
20.3	35	259.28	11.898	939.2	1167.1	405.3	420	449.39	1.1061	775.2	1204.6
25.3	40	267.25	10.498	933.7	1169.7	425.3	440	454.02	1.0556	770.0	1204.6
30.3	45	274.44	9.401	928.6	1172.0	445.3	460	458.50	1.0094	764.9	1204.6
35.3	50	281.01	8.515	924.0	1174.1	465.3	480	462.82	0.9670	759.9	1204.5
40.3	55	287.07	7.787	919.6	1175.9	485.3	500	467.01	0.9278	755.0	1204.4
45.3	60	292.71	7.175	915.5	1177.6	585.3	600	486.21	0.7698	731.6	1203.2
50.3	65	297.97	6.655	911.6	1179.1	685.3	700	503.10	0.6554	709.7	1201.2
55.3	70	302.92	6.206	907.9	1180.6	785.3	800	518.23	0.5687	688.9	1198.6
60.3	75	307.60	5.816	904.5	1181.9	885.3	900	531.98	0.5006	668.8	1195.4
65.3	80	312.03	5.472	901.1	1183.1	985.3	1000	544.61	0.4456	649.4	1191.8
70.3	85	316.25	5.168	897.8	1184.2	1085.3	1100	556.31	0.4001	630.4	1187.8
75.3	90	320.27	4.896	894.7	1185.3	1185.3	1200	567.22	0.3619	611.7	1183.4
80.3	95	324.12	4.652	891.7	1186.2	1285.3	1300	577.46	0.3293	593.2	1178.6
85.3	100	327.81	4.432	888.8	1187.2	1385.3	1400	587.10	0.3012	574.7	1173.4
90.3	105	331.36	4.232	886.0	1188.1	1485.3	1500	596.23	0.2765	556.3	1167.9
95.3	110	334.77	4.049	883.2	1188.9	1585.3	1600	604.90	0.2548	538.0	1162.1
100.3	115	338.07	3.882	880.6	1189.7	1685.3	1700	613.15	0.2354	519.6	1155.9
105.3	120	341.25	3.728	877.9	1190.4	1785.3	1800	621.03	0.2179	501.1	1149.4
110.3	125	344.33	3.587	875.4	1191.1	1885.3	1900	628.58	0.2021	482.4	1142.4
115.3	130	347.32	3.455	872.9	1191.7	1985.3	2000	635.82	0.1878	463.4	1135.1
120.3	135	350.21	3.333	870.6	1192.4	2185.3	2200	649.46	0.1625	424.4	1119.2
125.3	140	353.02	3.220	868.2	1193.0	2385.3	2400	662.12	0.1407	382.7	1101.1
130.3	145	355.76	3.114	865.8	1193.5	2585.3	2600	673.94	0.1213	337.2	1080.2
135.3	150	358.42	3.015	863.6	1194.1	2785.3	2800	684.99	0.1035	284.7	1054.8
145.3	160	363.53	2.834	859.2	1195.1	2985.3	3000	695.36	0.0858	217.8	1020.3
155.3	170	368.41	2.675	854.9	1196.0	3185.3	3200	705.11	0.0580	62.0	934.4
165.3	180	373.06	2.532	850.8	1196.9	3191.5	3206.2	705.40	0.0503	0	902.7

Printed in U. S. A. 9-38

EHRET INSULATIONS

Superheated Steam Table

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Abs. Press. lbs./sq.in. (Sat. Temp.)		Sat. Vapor	TEMPERATURE in Degrees F. 500°	600°	700°	800°	900°	1000°
80 (312.03)	v	5.472	7.020	7.797	8.562	9.322	10.077	10.830
	h	1183.1	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3
	s	1.6207	1.7346	1.7836	1.8281	1.8694	1.9079	1.9442
100 (327.81)	v	4.432	5.589	6.218	6.835	7.446	8.052	8.656
	h	1187.2	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8
	s	1.6026	1.7085	1.7581	1.8029	1.8443	1.8829	1.9193
120 (341.25)	v	3.728	4.636	5.165	5.683	6.195	6.702	7.207
	h	1190.4	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2
	s	1.5878	1.6869	1.7370	1.7822	1.8237	1.8625	1.8990
140 (353.02)	v	3.220	3.954	4.413	4.861	5.301	5.738	6.172
	h	1193.0	1275.2	1326.4	1376.8	1427.3	1478.2	1529.7
	s	1.5751	1.6683	1.7190	1.7645	1.8063	1.8451	1.8817
160 (363.53)	v	2.834	3.443	3.849	4.244	4.631	5.015	5.396
	h	1195.1	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1
	s	1.5640	1.6519	1.7033	1.7491	1.7911	1.8301	1.8667
180 (373.06)	v	2.532	3.044	3.411	3.764	4.110	4.452	4.792
	h	1196.9	1271.0	1323.5	1374.7	1425.6	1476.8	1528.6
	s	1.5542	1.6373	1.6894	1.7355	1.7776	1.8167	1.8534
200 (381.79)	v	2.288	2.726	3.060	3.380	3.693	4.002	4.309
	h	1198.4	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0
	s	1.5453	1.6240	1.6767	1.7232	1.7655	1.8048	1.8415
220 (389.86)	v	2.087	2.465	2.772	3.066	3.352	3.634	3.913
	h	1199.6	1266.7	1320.7	1372.6	1424.0	1475.5	1527.5
	s	1.5372	1.6117	1.6652	1.7120	1.7545	1.7939	1.8308
240 (397.37)	v	1.9183	2.247	2.533	2.804	3.068	3.327	3.584
	h	1200.6	1264.5	1319.2	1371.5	1423.2	1474.8	1526.9
	s	1.5298	1.6003	1.6546	1.7017	1.7444	1.7839	1.8209
260 (404.42)	v	1.7748	2.063	2.330	2.582	2.827	3.067	3.305
	h	1201.5	1262.3	1317.7	1370.4	1422.3	1474.2	1526.3
	s	1.5229	1.5897	1.6447	1.6922	1.7352	1.7748	1.8118
280 (411.05)	v	1.6511	1.9047	2.156	2.392	2.621	2.845	3.066
	h	1202.3	1260.0	1316.2	1369.4	1421.5	1473.5	1525.8
	s	1.5164	1.5796	1.6354	1.6834	1.7265	1.7662	1.8033
300 (417.33)	v	1.5433	1.7675	2.005	2.227	2.442	2.652	2.859
	h	1202.8	1257.6	1314.7	1368.3	1420.6	1472.8	1525.2
	s	1.5104	1.5701	1.6268	1.6751	1.7184	1.7582	1.7954
320 (423.29)	v	1.4485	1.6472	1.8734	2.083	2.285	2.483	2.678
	h	1203.4	1255.2	1313.2	1367.2	1419.8	1472.1	1524.7
	s	1.5046	1.5611	1.6186	1.6673	1.7108	1.7508	1.7880
340 (428.97)	v	1.3645	1.5410	1.7569	1.9562	2.147	2.334	2.518
	h	1203.7	1252.8	1311.6	1366.1	1419.0	1471.5	1524.1
	s	1.4992	1.5524	1.6108	1.6599	1.7036	1.7437	1.7811
360 (434.40)	v	1.2895	1.4464	1.6533	1.8431	2.025	2.202	2.376
	h	1204.1	1250.3	1310.1	1365.0	1418.1	1470.8	1523.5
	s	1.4941	1.5440	1.6033	1.6529	1.6968	1.7371	1.7745
380 (439.60)	v	1.2222	1.3616	1.5605	1.7419	1.9149	2.083	2.249
	h	1204.3	1247.7	1308.5	1363.8	1417.3	1470.1	1523.0
	s	1.4891	1.5359	1.5962	1.6462	1.6904	1.7307	1.7683
400 (444.59)	v	1.1613	1.2851	1.4770	1.6508	1.8161	1.9767	2.134
	h	1204.5	1245.1	1306.9	1362.7	1416.4	1469.4	1522.4
	s	1.4844	1.5281	1.5894	1.6398	1.6842	1.7247	1.7623
420 (449.39)	v	1.1061	1.2158	1.4014	1.5684	1.7267	1.8802	2.031
	h	1204.6	1242.5	1305.3	1361.6	1415.5	1468.7	1521.9
	s	1.4799	1.5205	1.5829	1.6337	1.6783	1.7189	1.7566

Abs. Press. lbs./sq.in. (Sat. Temp.)		Sat. Vapor	TEMPERATURE in Degrees F. 500°	600°	700°	800°	900°	1000°
440 (454.02)	v	1.0556	1.1526	1.3327	1.4934	1.6454	1.7925	1.9368
	h	1204.6	1239.8	1303.6	1360.4	1414.7	1468.1	1521.3
	s	1.4755	1.5132	1.5765	1.6278	1.6727	1.7135	1.7512
460 (458.50)	v	1.0094	1.0948	1.2698	1.4250	1.5711	1.7124	1.8508
	h	1204.6	1237.0	1302.0	1359.3	1413.8	1467.4	1520.7
	s	1.4713	1.5059	1.5705	1.6222	1.6673	1.7082	1.7460
480 (462.82)	v	0.9670	1.0417	1.2122	1.3622	1.5031	1.6390	1.7720
	h	1204.5	1234.2	1300.3	1358.2	1412.9	1466.7	1520.2
	s	1.4673	1.4989	1.5545	1.6167	1.6621	1.7031	1.7411
500 (467.01)	v	0.9278	0.9927	1.1591	1.3044	1.4405	1.5715	1.6996
	h	1204.4	1231.3	1298.6	1357.0	1412.1	1466.0	1519.6
	s	1.4634	1.4919	1.5588	1.6115	1.6571	1.6982	1.7363
550 (476.94)	v	0.8419	0.8852	1.0431	1.1783	1.3038	1.4241	1.5414
	h	1203.9	1223.7	1294.3	1354.0	1409.9	1464.3	1518.2
	s	1.4542	1.4751	1.5451	1.5991	1.6452	1.6868	1.7250
600 (486.21)	v	0.7698	0.7947	0.9463	1.0732	1.1899	1.3013	1.4096
	h	1203.2	1215.7	1289.9	1351.1	1407.7	1462.5	1516.7
	s	1.4454	1.4586	1.5323	1.5875	1.6343	1.6762	1.7147
650 (494.90)	v	0.7083	0.7173	0.8641	0.9841	1.0934	1.1973	1.2981
	h	1202.3	1207.2	1285.3	1348.0	1405.4	1460.8	1515.3
	s	1.4373	1.4424	1.5201	1.5767	1.6242	1.6665	1.7052
700 (503.10)	v	0.6554	.....	0.7934	0.9077	1.0108	1.1082	1.2024
	h	1201.2	.....	1280.6	1345.0	1403.2	1459.0	1513.9
	s	1.4296	.....	1.5084	1.5665	1.6147	1.6573	1.6963
750 (510.86)	v	0.6093	.....	0.7319	0.8414	0.9391	1.0310	1.1196
	h	1200.0	.....	1275.7	1341.8	1400.9	1457.2	1512.4
	s	1.4223	.....	1.4972	1.5558	1.6057	1.6487	1.6879
800 (518.23)	v	0.5687	.....	0.6779	0.7833	0.8763	0.9633	1.0470
	h	1198.6	.....	1270.7	1338.6	1398.6	1455.4	1511.0
	s	1.4153	.....	1.4863	1.5476	1.5972	1.6407	1.6801
850 (525.26)	v	0.5327	.....	0.6301	0.7320	0.8209	0.9037	0.9830
	h	1197.1	.....	1265.5	1335.4	1396.3	1453.6	1509.5
	s	1.4085	.....	1.4756	1.5388	1.5892	1.6330	1.6727
900 (531.98)	v	0.5006	.....	0.5873	0.6863	0.7716	0.8506	0.9262
	h	1195.4	.....	1260.1	1332.1	1393.9	1451.8	1508.1
	s	1.4020	.....	1.4653	1.5303	1.5814	1.6257	1.6656
950 (538.42)	v	0.4717	.....	0.5489	0.6453	0.7275	0.8031	0.8753
	h	1193.7	.....	1254.6	1328.7	1391.6	1450.0	1506.6
	s	1.3958	.....	1.4551	1.5221	1.5741	1.6187	1.6589
1000 (544.61)	v	0.4456	.....	0.5140	0.6084	0.6878	0.7604	0.8294
	h	1191.8	.....	1248.8	1325.3	1389.2	1448.2	1505.1
	s	1.3897	.....	1.4450	1.5141	1.5670	1.6121	1.6525
1500 (596.23)	v	0.2765	.....	0.2815	0.3719	0.4352	0.4893	0.5390
	h	1167.9	.....	1174.5	1287.2	1363.8	1429.3	1490.1
	s	1.3351	.....	1.3412	1.4434	1.5068	1.5559	1.6001
2000 (635.82)	v	0.1878	.....	.....	0.2489	0.3074	0.3532	0.3935
	h	1135.1	.....	.....	1240.0	1335.5	1409.2	1474.5
	s	1.2849	.....	.....	1.3783	1.4576	1.5139	1.5603
2500 (668.13)	v	0.1307	.....	.....	0.1686	0.2294	0.2710	0.3061
	h	1091.1	.....	.....	1176.8	1303.6	1387.8	1458.4
	s	1.2322	.....	.....	1.3073	1.4127	1.4772	1.5273
3000 (695.36)	v	0.0858	.....	.....	0.0984	0.1760	0.2159	0.2476
	h	1020.3	.....	.....	1060.7	1267.2	1365.0	1441.8
	s	1.1615	.....	.....	1.1966	1.3690	1.4439	1.4984

v—Specific Volume, cu. ft. per lb. h—enthalpy, BTUs per lb. s—entropy, BTUs per deg. F. per lb.

Weights and Measures

United States or British Standard

Long Measure

12 inches = 1 foot
3 feet = 1 yard
1,760 yards, or 5,280 feet = 1 mile
1,000 mils = 1 inch
5½ yards or 16½ feet = 1 rod

Square Measure

144 sq. inches, or 183.35 circular inches = 1 sq. foot
9 sq. feet = 1 sq. yard
30¼ sq. yards, or 272¼ sq. feet = 1 sq. rod
10 sq. chains, or 160 sq. rods, or 4,840 sq. yards, or 43,560 sq. feet = 1 acre
640 acres = 1 sq. mile

Solid or Cubic Measure

1,728 cu. inches = 1 cu. foot
27 cu. feet = 1 cu. yard
1 cord of wood = a pile, 4 × 4 × 8 feet = 128 cu. feet
1 perch of masonry = 16½ × 1½ × 1 foot = 24¾ cu. feet

Liquid Measure

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon { U. S. 231 cu. inches / Eng. 277.274 cu. inches
7.4805 gallons = 1 cu. foot
277.274 cu. inches = 1 British Imperial gallon

Dry Measure, U. S.

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
2,150.42 cu. inches = 1 U. S. standard struck bushel
1.2445 cu. feet = 1 U. S. standard struck bushel
2,218.192 cu. inches = 1 British Imperial bushel
1.2837 cu. feet = 1 British Imperial bushel

Shipping Measure

For measurement of cargo

1 U. S. shipping ton = 40 cu. ft. = { 31.16 Imp. bu. / 32.143 U. S. bu.
1 British shipping ton = 42 cu. ft. = { 32.719 Imp. bu. / 33.75 U. S. bu.

Measures of Weight, Avoirdupois

16 drachms, or 437.5 grains = 1 ounce, oz.
16 ounces, or 7,000 grains = 1 pound, lb.
28 pounds = 1 quarter, qr.
4 quarters = 1 hundredweight, cwt. = 112 lb.
20 hundredweight = 1 ton of 2,240 lbs. gross or long ton
2,000 pounds = 1 net, or short ton
2,204.6 pounds = 1 metric ton

Metric and United States or British Equivalents

Measure of Length

METRIC	BRITISH AND U. S.
1 meter	= 39.37 inches, or 3.28083 feet, or 1.09361 yards
0.3048 meter	= 1 foot
1 centimeter	= 0.3937 inch
2.54 centimeters	= 1 inch
1 millimeter	= 0.03937 inch, or 1-25 inch, nearly
25.4 millimeters	= 1 inch
1 kilometer	= 1,093.61 yards, or 0.62137 mile

Surface

METRIC	BRITISH AND U. S.
1 sq. meter	= { 10.764 sq. feet / 1.196 sq. yards
0.836 sq. meter	= 1 sq. yard
0.0929 sq. meter	= 1 sq. foot
1 sq. centimeter	= 0.155 sq. inch
6.452 sq. centimeters	= 1 sq. inch
1 sq. millimeter	= 0.00155 sq. inch = 1973.5 circular millimeters
645.2 sq. millimeters	= 1 sq. inch
1 centiare = 1 sq. meter	= 10.764 sq. feet
1 are = 1 sq. decameter	= 1076.41 sq. feet
1 sq. kilometer	= 0.386109 sq. miles = 247.11 acres
1 sq. myriameter	= 38.6109 sq. miles

Weight

METRIC	BRITISH AND U. S.
1 gram	= 15.432 grains
0.0648 gram	= 1 grain
28.35 gram	= 1 ounce avoirdupois
1 kilogram	= 2.2046 pounds
0.4536 kilogram	= 1 pound
1 tonne or metric ton	= { 0.9842 ton of 2,240 pounds / 19.68 cwts.
1,000 kilograms	= { 2,204.6 pounds

Weight—Continued

1.016 metric tons / 1016 kilograms = 1 ton of 2,240 pounds

Volume

METRIC	BRITISH AND U. S.
1 cu. meter	= { 35.314 cu. feet / 1.308 cu. yards
0.7645 cu. meter	= 1 cu. yard
0.02832 cu. meter	= 1 cu. foot
1 cu. decimeter	= { 61.023 cu. inches / 0.0353 cu. foot
28.32 cu. decimeters	= 1 cu. foot
1 cu. centimeter	= 0.061 cu. inch
16.387 cu. centimeters	= 1 cu. inch
1 cu. centimeter = 1 milliliter	= 0.061 cu. inch
1 centiliter	= 0.610 cu. inch
1 deciliter	= 6.102 cu. inch
1 liter = 1 cu. decimeter	= 61.023 cu. inch = 1.05671 quarts, U. S.
1 hectoliter or decistere	= 3.5314 cu. ft. = 2.8375 bushels, U. S.
1 stere, kiloliter or cubic meter	= 1.308 cu. yards = 28.37 bushels, U. S.

Capacity

METRIC	BRITISH AND U. S.
1 liter = 1 cu. decimeter	= { 61.023 cu. inches / 0.03531 cu. foot / 0.2642 gallon (American) / 2.202 pounds of water at 62° F.
28.317 liters	= 1 cu. foot
4.543 liters	= 1 gallon (British)
3.785 liters	= 1 gallon (American)

Printed in U. S. A. 9-38

EHRET
INSULATIONS

Conversion Factors

	BTU	cal.	Cal.	Foot Pounds	Watt Hours	Kilowatt Hours	Horse-power Hours	Joules	Kilogram-Meters
1 B. t. u. equals	1.	252.	0.252	777.5	0.2927	.0002927	.0003923	1054.	107.6
1 calorie equals	.003968	1	0.001	3.084	.001161	.000001161	.000001557	4.183	.4266
1 Calorie equals	3.968	1000.	1	3084.	1.61	.001161	.001557	4183.	426.6
1 foot pound equals	.001286	.3243	.0003243	1	.0003767	.0000003767	.0000005049	1.356	.1383
1 watt hour equals	3.417	861.1	.8611	2655.	1	.001	.001341	3601.	.367.7
1 kilowatt hour equals	3417.	861100	861.1	2655000.	1000.	1.	1.341	3601000.	367700.
1 horse-power hour equals	2549.	642300	6423	1981000.	746.	0.746	1	2684000.	273700.
1 joule equals	.0009477	.2388	.0002388	.7373	.000278	.000000278	.000000372	1	0.102
1 kilogram-meter equals	.009302	2.344	.002344	7.233	.00272	.00000272	.00000365	9.807	1

Table of Water Heads and Equivalent Pressures

Head in Feet	Pressure Lbs. per Sq. In.	Head in Feet	Pressure Lbs. per Sq. In.	Head in Feet	Pressure Lbs. per Sq. In.	Head in Feet	Pressure Lbs. per Sq. In.
5	2.17	80	34.64	275	119.08	700	303.10
10	4.33	90	38.97	300	129.90	750	324.75
15	6.50	100	43.30	350	151.55	800	346.40
20	8.66	125	54.13	400	173.20	850	368.05
30	12.99	150	64.95	450	194.85	900	389.70
40	17.32	175	75.78	500	216.50	950	411.35
50	21.65	200	86.60	550	238.15	1000	433.00
60	25.98	225	97.43	600	259.80	1100	476.30
70	30.31	250	108.25	650	281.45	1200	519.60

Table of Pressure Equivalents

Lbs. Per Sq. In.	Oz. Per Sq. In.	Ft. H_2O Pressure	Inches H_2O	Cm. H_2O	Cm. Kerosene	Inches Kerosene	Inches Hg.	Cm. Hg.
1.000	16.000	2.309	27.710	70.480	89.200	35.380	2.040	5.900
.063	1.000	.144	1.732	44.503	5.575	2.190	.127	.325
.433	6.928	1.000	12.000	30.360	38.560	15.120	.888	2.259
.036	.572	.083	1.000	2.530	3.188	1.260	.074	.187
.014	.224	.033	.393	1.000	1.260	.446	.029	.074
.028	.448	.064	.790	2.030	2.530	1.000	.058	.147
.011	.017	.026	.311	.790	1.000	.393	.023	.058
.490	2.840	1.130	13.590	34.380	43.410	17.200	1.000	2.530
.190	3.040	.441	5.299	13.590	17.200	6.742	.393	1.000

Decimal Equivalents of Fractions of One Inch

1/64	.0156	17/64	.2656	33/64	.5156	49/64	.7656
1/32	.0312	9/32	.2812	17/32	.5312	25/32	.7812
3/64	.0468	19/64	.2969	35/64	.5469	51/64	.7969
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.0781	21/64	.3281	37/64	.5781	53/64	.8281
3/32	.0937	11/32	.3437	19/32	.5937	27/32	.8437
7/64	.1093	23/64	.3594	39/64	.6094	55/64	.8594
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9/64	.1406	25/64	.3906	41/64	.6406	57/64	.8906
5/32	.1562	13/32	.4062	21/32	.6562	29/32	.9062
11/64	.1718	27/64	.4219	43/64	.6719	59/64	.9219
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.2031	29/64	.4531	45/64	.7031	61/64	.9531
7/32	.2187	15/32	.4687	23/32	.7187	31/32	.9687
15/64	.2344	31/64	.4844	47/64	.7344	63/64	.9844
1/4	.25	1/2	.5	3/4	.75	1	1.0

Flow of Steam Through Pipes

Velocity 6000 feet per minute

Initial Gauge Pressure Pounds per square inch		NOMINAL SIZE OF PIPE															
		2½	3	3½	4	4½	5	6	7	8	9	10	12	14	15	16
		ACTUAL INTERNAL DIAMETER OF STANDARD PIPE															
		2.066	2.469	3.068	3.548	4.027	4.506	5.046	6.064	7.023	7.981	8.940	10.020	12.000	13.250	14.250	15.250
		Weight of Steam (W) in Pounds Per Minute and Loss of Pressure (P) in Pounds for 100 Feet of Pipe															
50	W	21.01	29.98	46.30	61.91	79.72	99.87	125.3	180.9	242.6	306.3	393.2	493.8	708.3	863.5	998.8	1144.0
	P	2.84	2.12	1.51	1.20	.99	.84	.72	.55	.45	.39	.33	.28	.23	.20	.18	.17
60	W	24.06	34.33	53.01	70.89	91.29	114.3	143.5	207.2	277.8	350.7	450.2	565.4	811.0	988.8	1144.0	1310.0
	P	3.26	2.43	1.72	1.38	1.14	.97	.82	.63	.52	.44	.38	.33	.26	.23	.21	.19
70	W	27.08	38.64	59.66	79.79	102.7	128.7	161.5	233.2	312.6	394.7	506.7	636.4	912.8	1113.0	1287.0	1474.0
	P	3.66	2.74	1.94	1.55	1.28	1.09	.92	.71	.58	.50	.43	.37	.29	.26	.24	.22
80	W	30.07	42.91	66.26	88.61	114.1	142.9	179.3	258.9	347.2	438.3	562.7	706.7	1014.0	1236.0	1429.0	1637.0
	P	4.07	3.04	2.15	1.72	1.42	1.21	1.03	.79	.65	.55	.47	.41	.33	.29	.26	.24
90	W	33.07	47.18	72.85	97.42	125.4	157.1	197.1	284.7	381.7	481.9	618.7	777.0	1114.0	1359.0	1572.0	1800.0
	P	4.47	3.34	2.37	1.89	1.56	1.32	1.13	.87	.71	.61	.52	.45	.36	.32	.29	.27
100	W	36.03	51.41	79.38	106.2	136.7	171.2	214.8	310.2	415.9	525.1	674.2	846.7	1214.0	1481.0	1712.0	1961.0
	P	4.89	3.64	2.58	2.06	1.71	1.45	1.23	.95	.78	.66	.57	.49	.39	.35	.32	.29
110	W	39.02	55.68	85.97	115.0	148.0	185.4	232.6	336.0	450.5	568.7	730.1	917.0	1315.0	1603.0	1855.0	2124.0
	P	5.28	3.94	2.79	2.23	1.85	1.57	1.33	1.03	.84	.72	.61	.53	.42	.37	.34	.32
125	W	43.44	61.98	95.70	128.0	164.8	206.4	259.0	374.0	501.5	633.1	812.8	1021.0	1464.0	1785.0	2065.0	2365.0
	P	5.87	4.39	3.11	2.49	2.06	1.74	1.48	1.15	.94	.80	.68	.59	.47	.42	.38	.35
		ACTUAL INTERNAL DIAMETER OF EXTRA STRONG PIPE															
		1.939	2.323	2.900	3.364	3.826	4.290	4.813	5.761	6.625	7.625	8.625	9.750	11.750	13.000	14.000	15.000
		Weight of Steam (W) in Pounds per Minute and Loss of Pressure (P) in Pounds for 100 Feet of Pipe															
150	W	44.70	64.16	99.99	134.5	174.0	218.8	275.4	394.6	521.8	691.2	884.4	1130.0	1641.0	2006.0	2327.0	2671.0
	P	7.64	5.66	3.97	3.15	2.67	2.19	1.85	1.44	1.19	.98	.84	.71	.56	.50	.45	.41
180	W	52.44	75.26	117.3	157.8	204.2	256.7	323.1	462.9	612.2	810.9	1038.0	1326.0	1926.0	2354.0	2730.0	3134.0
	P	8.97	6.64	4.66	3.70	3.13	2.57	2.17	1.69	1.39	1.15	.98	.84	.66	.58	.53	.49
200	W	57.58	82.65	128.8	173.3	224.2	281.9	354.8	508.3	672.2	890.4	1139.0	1456.0	2114.0	2584.0	2998.0	3441.0
	P	9.86	7.31	5.12	4.07	3.44	2.82	2.39	1.85	1.53	1.27	1.08	.92	.73	.64	.59	.53
220	W	62.63	89.89	140.1	188.5	243.8	306.6	385.9	552.8	731.1	968.4	1239.0	1583.0	2300.0	2811.0	3260.0	3743.0
	P	10.70	7.93	5.56	4.42	3.73	3.07	2.60	2.01	1.66	1.38	1.17	1.00	.79	.70	.64	.58
250	W	70.25	100.8	157.1	211.5	273.5	343.9	432.9	620.2	820.1	1086.0	1390.0	1776.0	2580.0	3155.0	3660.0	4201.0
	P	12.04	8.91	6.23	4.96	4.19	3.44	2.91	2.26	1.86	1.54	1.31	1.12	.89	.78	.72	.65
280	W	78.13	112.1	174.8	235.2	304.2	382.4	481.4	689.7	912.1	1208.0	1546.0	1975.0	2869.0	3507.0	4068.0	4670.0
	P	13.37	9.90	6.94	5.51	4.66	3.83	3.24	2.51	2.07	1.72	1.46	1.25	.99	.87	.80	.72
300	W	83.17	119.4	186.0	250.3	323.8	407.1	512.5	734.2	970.9	1286.0	1646.0	2103.0	3054.0	3736.0	4333.0	4974.0
	P	14.21	10.53	7.38	5.86	4.96	4.07	3.45	2.67	2.21	1.83	1.56	1.34	1.05	.93	.85	.77
350	W	95.97	137.7	214.7	288.9	373.6	469.8	591.3	847.2	1120.0	1484.0	1899.0	2426.0	3524.0	4310.0	4999.0	5740.0
	P	16.69	12.14	8.52	6.77	5.72	4.70	3.98	3.08	2.54	2.11	1.79	1.53	1.21	1.07	.98	.89

Velocity of Flow of Water

In feet per minute, through pipes of various sizes, for varying quantities of flow

Gallons per Minute	¾ inch	1 inch	1¼ inch	1½ inch	2 inch	2½ inch	3 inch	4 inch
5	218	122½	78½	54½	30½	19½	13½	7⅔
10	436	245	157	109	61	38	27	15⅓
15	653	367½	235½	163½	91½	58½	40½	23
20	872	490	314	218	122	78	54	30⅔
25	1090	612½	392½	272½	152½	97½	67½	38⅓
30	....	735	451	327	183	117	81	46
35	....	857½	549½	381½	213½	136½	94½	53⅔
40	....	980	628	436	244	156	108	61⅓
45	....	1102½	706½	490½	274½	175½	121½	69
50	....	.....	785	545	305	195	135	76⅔
75	....	.....	1177½	817½	457½	292½	202½	115
100	....	.....	.....	1090	610	380	270	153⅓
125	....	.....	.....	.....	762½	487½	337½	191⅔
150	....	.....	.....	.....	915	585	405	230
175	....	.....	.....	.....	1067½	682½	472½	268⅓
200	....	.....	.....	.....	1220	780	540	306⅔

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Number of Gallons in Round Tanks

Depth or Length	DIAMETER									
	18-inch	24-inch	30-inch	36-inch	42-inch	48-inch	54-inch	60-inch	66-inch	72-inch
1 Inch	1.10	1.96	3.06	4.41	5.99	7.83	9.91	12.24	14.81	17.62
1 ft.	13.	23.	37.	53.	72.	94.	119.	147.	178.	211.
1½ ft.	20.	35.	55.	79.	108.	141.	179.	220.	267.	317.
2 ft.	26.	47.	73.	106.	144.	188.	238.	294.	355.	423.
2½ ft.	33.	59.	92.	132.	180.	235.	298.	367.	444.	529.
3 ft.	40.	71.	110.	159.	216.	282.	357.	441.	533.	634.
3½ ft.	46.	82.	129.	185.	252.	329.	417.	514.	622.	740.
4 ft.	53.	94.	147.	211.	288.	376.	476.	587.	711.	846.
4½ ft.	59.	106.	165.	238.	324.	423.	536.	661.	800.	952.
5 ft.	66.	118.	183.	264.	360.	470.	597.	734.	889.	1157.
5½ ft.	73.	129.	202.	291.	396.	517.	657.	808.	977.	1263.
6 ft.	79.	141.	220.	317.	432.	564.	714.	881.	1066.	1369.
7 ft.	92.	164.	257.	370.	504.	658.	833.	1028.	1244.	1580.
8 ft.	106.	188.	294.	423.	576.	752.	952.	1175.	1422.	1792.
9 ft.	119.	212.	330.	476.	648.	846.	1071.	1322.	1599.	2003.
10 ft.	132.	235.	367.	529.	720.	940.	1190.	1469.	1777.	2115.
12 ft.	157.	282.	440.	634.	864.	1128.	1428.	1762.	2133.	2537.
14 ft.	185.	329.	514.	740.	1008.	1316.	1666.	2056.	2488.	2960.
16 ft.	211.	376.	587.	846.	1152.	1504.	1904.	2350.	2844.	3383.
18 ft.	238.	423.	661.	952.	1296.	1692.	2142.	2644.	3199.	3806.
20 ft.	264.	470.	734.	1057.	1440.	1880.	2380.	2937.	3554.	4229.

One-inch depth is given to facilitate figuring intermediate depths.

For tanks having a diameter other than those given in the table, multiply the square of the diameter in inches by the length in feet and multiply this product by 0.0408 to obtain tank capacity in U. S. gallons. When both diameter and length are given in inches, the capacity in U. S. gallons equals $0.0034 \times d^2L$.

Weight of Fresh Water in Pipes

Per lineal foot

Pipe Size	Pounds Water	Pipe Size	Pounds Water	Pipe Size	Pounds Water
1″	.3405	4″	5.4476	10″	34.048
1¼″	.5320	4½″	6.8946	12″	49.028
1½″	.7661	5″	8.5119	14″	66.733
2″	1.3619	6″	12.257	15″	76.607
2½″	2.1280	7″	16.683	16″	87.162
3″	3.0643	8″	21.790	18″	110.31
3½″	4.1708	9″	27.579	20″	136.19

To find number of gallons divide the weight in pounds by 8.35, the number of pounds to one gallon.

Useful Formulae

$\pi = 3.1415926536$	$\frac{\pi}{4} = 0.7854$	$\frac{1}{\pi} = 0.31831$	$\pi^2 = 9.96960$	$\sqrt{\pi} = 1.77245$
$\frac{\pi}{2} = 1.5708$	$\frac{\pi}{12} = 0.2618$	$\frac{1}{\pi^2} = 0.10132$	$\pi^3 = 31.00628$	$\sqrt{\frac{1}{\pi}} = 0.56419$
$\frac{\pi}{3} = 1.0472$	$\frac{\pi}{64} = 0.04909$		log. $\pi = 0.4971499$	log. $\sqrt{\pi} = 0.2485749$

$$\text{Diameter} = \frac{226 \times \text{Circumference}}{710}$$

$$\text{Circumference} = \frac{710 \times \text{Diameter}}{226}$$

$$\text{Diameter} = \frac{99 \times \text{Side Inscribed Square}}{70}$$

$$\text{Side Inscribed Square} = \frac{70 \times \text{Diameter}}{99}$$

$$\text{Diameter} = \frac{70 \times \text{Side of Equal Square}}{79}$$

$$\text{Side of Equal Square} \quad \frac{79 \times \text{Diameter}}{70}$$

$$\text{Circumference} = \frac{39 \times \text{Side of Equal Square}}{11}$$

$$\text{Side of Equal Square} = \frac{11 \times \text{Circumference}}{39}$$

$$\text{Diagonal of Square} = \frac{99 \times \text{Side of Square}}{70}$$

$$\text{Side of Square} = \frac{70 \times \text{Diagonal of Square}}{99}$$

$$\text{Area of Circle} = \frac{322 \times \text{Area of Inscribed Square}}{205}$$

$$\text{Atmospheres} = \frac{23 \times \text{Feet of Water}}{780}$$

$$\text{Feet of Water} = \frac{780 \times \text{Atmosphere}}{23}$$

$$\text{Pounds per Sq. Inch} = \frac{29 \times \text{Feet of Water}}{67}$$

$$\text{Feet of Water} = \frac{67 \times \text{Pounds per Sq. Inch}}{29}$$

$$\text{Pounds per Sq. Foot} = \frac{51 \times \text{Kilograms per Sq. Meter}}{249}$$

$$\text{Kilograms per Sq. Meter} = \frac{249 \times \text{Pounds per Sq. Foot}}{51}$$

$$\text{Inches of Mercury} = \frac{57 \times \text{Pounds per Sq. Inch}}{28}$$

$$\text{Pounds per Sq. Inch} = \frac{28 \times \text{Inches of Mercury}}{57}$$

$$\text{Inches of Water} = \frac{720 \times \text{Pounds per Sq. Inch}}{26}$$

$$\text{Pounds per Sq. Inch} = \frac{26 \times \text{Inches of Water}}{720}$$

$$\text{Feet of Water} = \frac{60 \times \text{Pounds per Sq. Inch}}{26}$$

$$\text{Pounds per Sq. Inch} = \frac{26 \times \text{Feet of Water}}{60}$$

$$\text{Inches of Mercury} = \frac{15 \times \text{Feet of Water}}{17}$$

$$\text{Feet of Water} = \frac{17 \times \text{Inches of Mercury}}{15}$$

PRACTICAL ELECTRICAL FORMULAE FUNDAMENTALLY DERIVED

R = Resistance in ohms. E = E.M.F. in volts.
I = Current in amperes. W = Watts.

$$R = \frac{E}{I} = \frac{W}{I^2} = \frac{E^2}{W} \qquad I = \frac{E}{R} = \frac{W}{E} = \frac{1}{\sqrt{\frac{W}{R}}} \qquad E = \frac{W}{I} = IR = \frac{1}{\sqrt{WR}}$$

$$W = EI = I^2R = \frac{E^2}{R}$$

RELATION OF HORSEPOWER TO ELECTROMAGNETIC UNITS

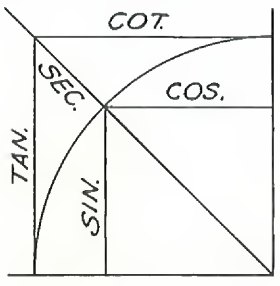
Since 1 watt equals 1/746 of a horsepower, the relations are as follows:

$$\text{H.P.} = \frac{W}{746} = \frac{EI}{746} = \frac{I^2R}{746} \qquad \text{H.P.} = \frac{\frac{E^2}{R}}{746} = \frac{\text{K.W.} \times 1{,}000}{746}$$

$$\text{K.W.} = \frac{\text{H.P.} \times 746}{1{,}000}$$

FUNCTIONS OF ANGLES

	0°	30°	45°	60°	90°	180°	270°	360°
Sin.....	0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$	1	0	—1	0
Cos.....	1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$	0	—1	0	1
Tan.....	0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$	∞	0	∞	0
Cot.	∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$	0	∞	0	∞
Sec.....	1	$\frac{2}{3}\sqrt{3}$	$\sqrt{2}$	2	∞	—1	∞	1
CSC.	∞	2	$\sqrt{2}$	$\frac{2}{3}\sqrt{3}$	1	∞	—1	∞



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Melting Points

Metals and Alloys	Degrees Centigrade	Degrees Fahrenheit
Aluminum	658.9	1218.
Bronze (about)	1050.	1920.
Brass (about)	940.	1720.
Cast iron, gray	1230.	2250.
Cast iron, white	1150.	2100.
Copper	1083.1	1981.6
Gold	1062.6	1944.7
Iron, wrought	1510.	2750.
Lead	327.4	621.3
Nickel	1452.	2646.
Platinum	1755.	3191.
Silver	960.5	1760.9
Tin	231.9	449.3
Zinc	419.5	787.1

Minerals and Oxides	Degrees Centigrade	Degrees Fahrenheit
Alumina (Al_2O_3)	2050	3722
Chromite ($FeOCr_2O_3$)	2180	3956
Forsterite	1910	3470
Lime (CaO)	2570	4658
Magnesia (MgO)	2800	5072
Silica cristobalite	1713	3115

Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) has a P.C.E. value of cone 35 corresponding to 1785°C. (3245°F.).

Mullite ($3Al_2O_3 \cdot 2SiO_2$) melts incongruently at 1810°C. (3290°F.) to form corundum and a silicious liquid. It is completely melted at 1920°C. (3488°F.).

Fusing Points of Seger Cones

Number of Cone	Fusing Point Original Scale		Number of Cone	Fusing Point Original Scale	
	Degrees Fahr.	Degrees Centig.		Degrees Fahr.	Degrees Centig.
1	2,102	1,150	21	2,822	1,550
2	2,138	1,170	22	2,858	1,570
3	2,174	1,190	23	2,894	1,590
4	2,210	1,210	24	2,930	1,610
			25	2,966	1,630
5	2,246	1,230			
6	2,282	1,250	26	3,002	1,650
7	2,318	1,270	27	3,038	1,670
8	2,354	1,290	28	3,074	1,690
9	2,390	1,310	29	3,110	1,710
			30	3,146	1,730
10	2,426	1,330	31	3,182	1,750
11	2,462	1,350	32	3,218	1,770
12	2,498	1,370	33	3,254	1,790
13	2,534	1,390	34	3,290	1,810
14	2,570	1,410	35	3,326	1,830
15	2,606	1,430			
			36	3,362	1,850
16	2,642	1,450	37	3,398	1,870
17	2,678	1,470	38	3,434	1,890
18	2,714	1,490	39	3,470	1,910
19	2,750	1,510			
20	2,786	1,530			

Weights of Various Materials

Material	Average per Cubic Foot in Pounds	Material	Average per Cubic Foot in Pounds
BRICK		METALS—Continued	
Common	100	Copper, rolled or wire	555
Fireclay	120 to 140	Iron, cast	450
Silica	105	Iron, wrought	482
Chrome	175	Lead, cast	708
CEMENTS		Lead, rolled	711
Portland	78	Steel, cast	490
Hydraulic	60	Steel, rolled	495
FINE GROUND CLAYS, SILICA CEMENT, ETC.		Tin, cast	459
Fireclay	85	Zinc, cast	438
Silica cement	75	OILS	
Chrome cement	135	Engine	55
Grain magnesite (as shipped)	112	Crude	48
COAL AND COKE		Petroleum	55
Anthracite	60	Gasoline	43
Bituminous	49	ROCKS	
Charcoal	18.5	Chalk	145
Coke	26.3	Granite	165
CONCRETE		Gypsum	143
Cement, fine	137	Sandstone	144
Rubble, coarse	119	Pumice stone	57
EARTH		Quartz	165
Loam, dry, loose	76	Salt, coarse	45
Loam, packed	95	Salt, fine	49
Loam, soft, loose mud	108	Shales	162
Loam, dense mud	125	Slate, American	175
GLASS		SAND	
Common window	157	Dry and loose	100
Plate	172	Dry and packed	110
Flint	192	Wet and packed	130
Floor or skylight	158	Gravel packed	118
GRAINS		WATER	
Corn	45	Water as ice	58.7
Oats	24	Water at 32 degrees Fahrenheit	62.4
Wheat	48	Water at 212 degrees Fahrenheit	59.6
LIME		WOODS, DRY	
Quick, loose lumps	53	Apple	48
Quick, fine	75	Beech	43
Stone, large rocks	168	Birch	45
Stone, irregular lumps	96	Cedar, American	35
MASONRY		Chestnut	41
Granite or limestone	165	Ebony	76
Mortar, rubble	154	Elm	35
Dry	138	Hemlock	25
Sandstone, dressed	144	Hickory	53
METALS		Ironwood	114
Aluminum	166	Mahogany	35 to 53
Brass, cast	524	Maple	49
Bronze	534	Oak, live	59
Copper, cast	537	Oak, white	50
		Pine, white	25
		Pine, yellow northern	34
		Pine, yellow southern	45
		Spruce	25
		Black Walnut	35

Color Scale for Temperatures

Color	Degrees Centigrade	Degrees Fahrenheit
Lowest visible red	475	875
Lowest visible red to dark red	475 to 650	875 to 1200
Dark red to cherry red	650 to 750	1200 to 1375
Cherry red to bright cherry red	750 to 825	1375 to 1500
Bright cherry red to orange	825 to 900	1500 to 1650
Orange to yellow	900 to 1090	1650 to 2000
Yellow to light yellow	1090 to 1320	2000 to 2400
Light yellow to white	1320 to 1540	2400 to 2800
White to dazzling white	1540 and over	2800 and over

Fahrenheit and Centigrade Conversion Table

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
0	32	270	518	540	1004	810	1490	1080	1976	1350	2462
5	41	275	527	545	1013	815	1499	1085	1985	1355	2471
10	50	280	536	550	1022	820	1508	1090	1994	1360	2480
15	59	285	545	555	1031	825	1517	1095	2003	1365	2489
20	68	290	554	560	1040	830	1526	1100	2012	1370	2498
25	77	295	563	565	1049	835	1535	1105	2021	1375	2507
30	86	300	572	570	1058	840	1544	1110	2030	1380	2516
35	95	305	581	575	1067	845	1553	1115	2039	1385	2525
40	104	310	590	580	1076	850	1562	1120	2048	1390	2534
45	113	315	599	585	1085	855	1571	1125	2057	1395	2543
50	122	320	608	590	1094	860	1580	1130	2066	1400	2552
55	131	325	617	595	1103	865	1589	1135	2075	1405	2561
60	140	330	626	600	1112	870	1598	1140	2084	1410	2570
65	149	335	635	605	1121	875	1607	1145	2093	1415	2579
70	158	340	644	610	1130	880	1616	1150	2102	1420	2588
75	167	345	653	615	1139	885	1625	1155	2111	1425	2597
80	176	350	662	620	1148	890	1634	1160	2120	1430	2606
85	185	355	671	625	1157	895	1643	1165	2129	1435	2615
90	194	360	680	630	1166	900	1652	1170	2138	1440	2624
95	203	365	689	635	1175	905	1661	1175	2147	1445	2633
100	212	370	698	640	1184	910	1670	1180	2156	1450	2642
105	221	375	707	645	1193	915	1679	1185	2165	1455	2651
110	230	380	716	650	1202	920	1688	1190	2174	1460	2660
115	239	385	725	655	1211	925	1697	1195	2183	1465	2669
120	248	390	734	660	1220	930	1706	1200	2192	1470	2678
125	257	395	743	665	1229	935	1715	1205	2201	1475	2687
130	266	400	752	670	1238	940	1724	1210	2210	1480	2696
135	275	405	761	675	1247	945	1733	1215	2219	1485	2705
140	284	410	770	680	1256	950	1742	1220	2228	1490	2714
145	293	415	779	685	1265	955	1751	1225	2237	1495	2723
150	302	420	788	690	1274	960	1760	1230	2246	1500	2732
155	311	425	797	695	1283	965	1769	1235	2255	1505	2741
160	320	430	806	700	1292	970	1778	1240	2264	1510	2750
165	329	435	815	705	1301	975	1787	1245	2273	1515	2759
170	338	440	824	710	1310	980	1796	1250	2282	1520	2768
175	347	445	833	715	1319	985	1805	1255	2291	1525	2777
180	356	450	842	720	1328	990	1814	1260	2300	1530	2786
185	365	455	851	725	1337	995	1823	1265	2309	1535	2795
190	374	460	860	730	1346	1000	1832	1270	2318	1540	2804
195	383	465	869	735	1355	1005	1841	1275	2327	1545	2813
200	392	470	878	740	1364	1010	1850	1280	2336	1550	2822
205	401	475	887	745	1373	1015	1859	1285	2345	1555	2831
210	410	480	896	750	1382	1020	1868	1290	2354	1560	2840
215	419	485	905	755	1391	1025	1877	1295	2363	1565	2849
220	428	490	914	760	1400	1030	1886	1300	2372	1570	2858
225	437	495	923	765	1409	1035	1895	1305	2381	1575	2867
230	446	500	932	770	1418	1040	1904	1310	2390	1580	2876
235	455	505	941	775	1427	1045	1913	1315	2399	1585	2885
240	464	510	950	780	1436	1050	1922	1320	2408	1590	2894
245	473	515	959	785	1445	1055	1931	1325	2417	1595	2903
250	482	520	968	790	1454	1060	1940	1330	2426	1600	2912
255	491	525	977	795	1463	1065	1949	1335	2435	1700	3092
260	500	530	986	800	1472	1070	1958	1340	2444	1800	3272
265	509	535	995	805	1481	1075	1967	1345	2453	2000	3632

CONVERSION FORMULAE

To convert Centigrade to Fahrenheit:	To Convert Fahrenheit to Centigrade:
$C = \frac{F-32}{1.8}$	$F = 1.8 \times C + 32$

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Squares, Cubes, Square Roots and Cube Roots of Numbers from .1 to 99

No.	Square	Cube	Square Root	Cube Root
0.1	.01	.001	.3162	.4642
.15	.0225	.0034	.3873	.5313
.2	.04	.008	.4472	.5848
.25	.0625	.0156	.500	.6300
.3	.09	.027	.5477	.6694
.35	.1225	.0429	.5916	.7047
0.4	.16	.064	.6325	.7368
.45	.2025	.0911	.6708	.7663
.5	.25	.125	.7071	.7937
.55	.3025	.1664	.7416	.8193
.6	.36	.216	.7746	.8434
.65	.4225	.2746	.8062	.8662
0.7	.49	.343	.8367	.8879
.75	.5625	.4219	.8660	.9086
.8	.64	.512	.8944	.9283
.85	.7225	.6141	.9219	.9473
.9	.81	.729	.9487	.9655
.95	.9025	.8574	.9747	.9830
1.	1.	1.	1.	1.
.05	1.1025	1.158	1.025	1.016
.1	1.21	1.331	1.049	1.032
.15	1.3225	1.521	1.072	1.048
.2	1.44	1.728	1.095	1.063
1.25	1.5625	1.953	1.118	1.077
.3	1.69	2.197	1.140	1.091
.35	1.8225	2.460	1.162	1.105
.4	1.96	2.744	1.183	1.119
.45	2.1025	3.049	1.204	1.132
1.5	2.25	3.375	1.2247	1.1447
.55	2.4025	3.724	1.245	1.157
.6	2.56	4.096	1.265	1.170
.65	2.7225	4.492	1.285	1.182
.7	2.89	4.913	1.304	1.193
1.75	3.0625	5.359	1.323	1.205
.8	3.24	5.832	1.342	1.216
.85	3.4225	6.332	1.360	1.228
.9	3.61	6.859	1.378	1.239
.95	3.8025	7.415	1.396	1.249
2.	4.	8.	1.4142	1.2599
.1	4.41	9.261	1.449	1.281
.2	4.84	10.648	1.483	1.301
.3	5.29	12.167	1.517	1.320
.4	5.76	13.824	1.549	1.339
2.5	6.25	15.625	1.581	1.357
.6	6.76	17.576	1.612	1.375
.7	7.29	19.683	1.643	1.392
.8	7.84	21.952	1.673	1.409
.9	8.41	24.389	1.703	1.426
3.	9.	27.	1.7321	1.4422
.1	9.61	29.791	1.761	1.458
.2	10.24	32.768	1.789	1.474
.3	10.89	35.937	1.817	1.489
.4	11.56	39.304	1.844	1.504
3.5	12.25	42.875	1.871	1.518
.6	12.96	46.656	1.897	1.533
.7	13.69	50.653	1.924	1.547
.8	14.44	54.872	1.949	1.560
.9	15.21	59.319	1.975	1.574
4.	16.	64.	2.	1.5874
.1	16.81	68.921	2.025	1.601
.2	17.64	74.088	2.049	1.613
.3	18.49	79.507	2.074	1.626
.4	19.36	85.184	2.098	1.639
4.5	20.25	91.125	2.121	1.651
.6	21.16	97.336	2.145	1.663
.7	22.09	103.823	2.168	1.675
.8	23.04	110.592	2.191	1.687
.9	24.01	117.649	2.214	1.698
5.	25.	125.	2.2361	1.7100
.1	26.01	132.651	2.258	1.721
.2	27.04	140.608	2.280	1.732
.3	28.09	148.877	2.302	1.744
.4	29.16	157.464	2.324	1.754
5.5	30.25	166.375	2.345	1.765
.6	31.36	175.616	2.366	1.776
.7	32.49	185.193	2.387	1.786
.8	33.64	195.112	2.408	1.797
.9	34.81	205.379	2.429	1.807
6.	36.	216.	2.4495	1.8171
.1	37.21	226.981	2.470	1.827
.2	38.44	238.328	2.490	1.837
.3	39.69	250.047	2.510	1.847
.4	40.96	262.144	2.530	1.857
6.5	42.25	274.625	2.550	1.866
.6	43.56	287.496	2.569	1.876
.7	44.89	300.763	2.588	1.885
.8	46.24	314.432	2.608	1.895
.9	47.61	328.509	2.627	1.904
7.	49.	343.	2.6458	1.9129
.1	50.41	357.911	2.665	1.922
.2	51.84	373.248	2.683	1.931
.3	53.29	389.017	2.702	1.940
.4	54.76	405.224	2.720	1.949
7.5	56.25	421.875	2.739	1.957
.6	57.76	438.976	2.757	1.966
.7	59.29	456.533	2.775	1.975
.8	60.84	474.552	2.793	1.983
.9	62.41	493.039	2.811	1.992
8.	64.	512.	2.8284	2.
.1	65.61	531.441	2.846	2.008
.2	67.24	551.368	2.864	2.017
.3	68.89	571.787	2.881	2.025
.4	70.56	592.704	2.898	2.033
8.5	72.25	614.125	2.915	2.041
.6	73.96	636.056	2.933	2.049
.7	75.69	658.503	2.950	2.057
.8	77.44	681.472	2.966	2.065
.9	79.21	704.969	2.983	2.072
9.	81.	729.	3.	2.0801
.1	82.81	753.571	3.017	2.088
.2	84.64	778.688	3.033	2.095
.3	86.49	804.357	3.050	2.103
.4	88.36	830.584	3.066	2.110
9.5	90.25	857.375	3.082	2.118
.6	92.16	884.736	3.098	2.125
.7	94.09	912.673	3.114	2.133
.8	96.04	941.192	3.130	2.140
.9	98.01	970.299	3.146	2.147
10.	100.	1000.	3.1623	2.1544
11.	121.	1331.	3.3166	2.2240
12.	144.	1728.	3.4641	2.2894
13.	169.	2197.	3.6056	2.3513
14.	196.	2744.	3.7417	2.4101
15.	225.	3375.	3.8730	2.4662
16.	256.	4096.	4.	2.5198
17.	289.	4913.	4.1231	2.5713
18.	324.	5832.	4.2426	2.6207
19.	361.	6859.	4.3589	2.6684
20.	400.	8000.	4.4721	2.7144
21.	441.	9261.	4.5826	2.7589
22.	484.	10648.	4.6904	2.8020
23.	529.	12167.	4.7958	2.8439
24.	576.	13824.	4.8990	2.8845
25.	625.	15625.	5.	2.9240
26.	676.	17576.	5.0990	2.9625
27.	729.	19683.	5.1962	3.
28.	784.	21952.	5.2915	3.0366
29.	841.	24389.	5.3852	3.0723
30.	900.	27000.	5.4772	3.1072
31.	961.	29791.	5.5678	3.1414
32.	1024.	32768.	5.6569	3.1748
33.	1089.	35937.	5.7446	3.2075
34.	1156.	39304.	5.8310	3.2396
35.	1225.	42875.	5.9161	3.2711
36.	1296.	46656.	6.	3.3019
37.	1369.	50653.	6.0828	3.3322
38.	1444.	54872.	6.1644	3.3620
39.	1521.	59319.	6.2450	3.3912
40.	1600.	64000.	6.3246	3.4200
41.	1681.	68921.	6.4031	3.4482
42.	1764.	74088.	6.4807	3.4760
43.	1849.	79507.	6.5574	3.5034
44.	1936.	85184.	6.6332	3.5303
45.	2025.	91125.	6.7082	3.5569
46.	2116.	97336.	6.7823	3.5830
47.	2209.	103823.	6.8557	3.6088
48.	2304.	110592.	6.9282	3.6342
49.	2401.	117649.	7.	3.6593
50.	2500.	125000.	7.0711	3.6840
51.	2601.	132651.	7.1414	3.7084
52.	2704.	140608.	7.2111	3 7325
53.	2809.	148877.	7.2801	3.7563
54.	2916.	157464.	7.3485	3.7798
55.	3025.	166375.	7.4162	3.8030
56.	3136.	175616.	7.4833	3.8259
57.	3249.	185193.	7.5498	3.8485
58.	3364.	195112.	7.6158	3.8709
59.	3481.	205379.	7.6811	3.8930
60.	3600.	216000.	7.7460	3.9149
61.	3721.	226981.	7.8102	3.9365
62.	3844.	238328.	7.8740	3.9579
63.	3969.	250047.	7.9373	3.9791
64.	4096.	262144.	8.	4.
65.	4225.	274625.	8.0623	4.0207
66.	4356.	287496.	8.1240	4.0412
67.	4489.	300763.	8.1854	4.0615
68.	4624.	314432.	8.2462	4.0817
69.	4761.	328509.	8.3066	4.1016
70.	4900.	343000.	8.3666	4.1213
71.	5041.	357911.	8.4261	4.1408
72.	5184.	373248.	8.4853	4.1602
73.	5329.	389017.	8.5440	4.1793
74.	5476.	405224.	8.6023	4.1983
75.	5625.	421875.	8.6603	4.2172
76.	5776.	438976.	8.7178	4.2358
77.	5929.	456533.	8.7750	4.2534
78.	6084.	474552.	8.8318	4.2727
79.	6241.	493039.	8.8882	4.2908
80.	6400.	512000.	8.9443	4.3089
81.	6561.	531441.	9.	4.3267
82.	6724.	551368.	9.0554	4.3445
83.	6889.	571787.	9.1104	4.3621
84.	7056.	592704.	9.1652	4.3795
85.	7225.	614125.	9.2195	4.3968
86.	7396.	636056.	9.2736	4.4140
87.	7569.	658503.	9.3276	4.4310
88.	7744.	681472.	9.3808	4.4480
89.	7921.	704969.	9.4340	4.4647
90.	8100.	729000.	9.4868	4.4814
91.	8281.	753571.	9.5394	4.4979
92.	8464.	778688.	9.5917	4.5144
93.	8649.	804357.	9.6437	4.5307
94.	8836.	830584.	9.6954	4.5468
95.	9025.	857375.	9.7468	4.5629
96.	9216.	884736.	9.7980	4.5789
97.	9409.	912673.	9.8489	4.5947
98.	9604.	941192.	9.8995	4.6104
99.	9801.	970299.	9.9499	4.6261

Circumferences and Areas of Circles

Diam.	Circ.	Area	Diam.	Circ.	Area	Diam.	Circ.	Area	Diam.	Circ.	Area
1/32	.0981	.00076	10	31.41	78.539	21	65.97	346.36	32	100.5	804.24
1/16	.1963	.00306	1/8	31.80	80.515	1/8	66.36	350.49	1/8	100.9	810.45
1/8	.3926	.01227	1/4	32.20	82.516	1/4	66.75	354.65	1/4	101.3	816.86
3/16	.5890	.02761	3/8	32.59	84.540	3/8	67.15	358.84	3/8	101.7	823.21
1/4	.7854	.04908	1/2	32.98	86.590	1/2	67.54	363.05	1/2	102.1	829.57
5/16	.9817	.07669	5/8	33.37	88.664	5/8	67.93	367.28	5/8	102.4	835.97
3/8	1.178	.1104	3/4	33.77	90.762	3/4	68.32	371.54	3/4	102.8	842.39
7/16	1.374	.1503	7/8	34.16	92.885	7/8	68.72	375.82	7/8	103.2	848.83
1/2	1.570	.1963									
9/16	1.767	.2485	11	34.55	95.033	22	69.11	380.13	33	103.6	855.30
5/8	1.963	.3097	1/8	34.95	97.205	1/8	69.50	384.46	1/8	104.0	861.79
11/16	2.159	.3712	1/4	35.34	99.402	1/4	69.90	388.82	1/4	104.4	868.30
3/4	2.356	.4417	3/8	35.73	101.62	3/8	70.29	393.20	3/8	104.8	874.88
13/16	2.552	.5184	1/2	36.12	103.86	1/2	70.68	397.60	1/2	105.2	881.41
7/8	2.748	.6013	5/8	36.52	106.13	5/8	71.07	402.03	5/8	105.6	888.00
15/16	2.945	.6902	3/4	36.91	108.43	3/4	71.47	406.49	3/4	106.0	894.61
			7/8	37.30	110.75	7/8	71.86	410.97	7/8	106.4	901.25
1	3.141	.7854									
1/8	3.534	.9940	12	37.69	113.00	23	72.25	415.47	34	106.8	907.92
1/4	3.927	1.227	1/8	38.09	115.46	1/8	72.64	420.00	1/8	107.2	914.61
3/8	4.319	1.484	1/4	38.48	117.85	1/4	73.04	424.55	1/4	107.5	921.32
1/2	4.712	1.767	3/8	38.87	120.27	3/8	73.43	429.13	3/8	107.9	928.06
5/8	5.105	2.073	1/2	39.27	122.71	1/2	73.82	433.73	1/2	108.3	934.82
3/4	5.497	2.405	5/8	39.66	125.18	5/8	74.21	438.30	5/8	108.7	941.60
7/8	5.890	2.761	3/4	40.05	127.67	3/4	74.61	443.01	3/4	109.1	948.41
			7/8	40.44	130.19	7/8	75.00	447.69	7/8	109.5	955.25
2	6.283	3.141									
1/8	6.675	3.546	13	40.84	132.73	24	75.39	452.39	35	109.9	962.11
1/4	7.068	3.976	1/8	41.23	135.29	1/8	75.79	457.11	1/8	110.3	968.99
3/8	7.461	4.430	1/4	41.62	137.88	1/4	76.18	461.86	1/4	110.7	975.90
1/2	7.854	4.908	3/8	42.01	140.50	3/8	76.57	466.63	3/8	111.1	982.84
5/8	8.246	5.411	1/2	42.41	143.13	1/2	76.96	471.43	1/2	111.5	989.80
3/4	8.639	5.939	5/8	42.80	145.80	5/8	77.36	476.25	5/8	111.9	996.78
7/8	9.032	6.491	3/4	43.19	148.48	3/4	77.75	481.10	3/4	112.3	1003.7
			7/8	43.58	151.20	7/8	78.14	485.97	7/8	112.7	1010.8
3	9.424	7.068									
1/8	9.817	7.669	14	43.98	153.93	25	78.54	490.87	36	113.0	1017.8
1/4	10.21	8.295	1/8	44.37	156.69	1/8	78.93	495.79	1/8	113.4	1024.9
3/8	10.60	8.946	1/4	44.76	159.48	1/4	79.32	500.74	1/4	113.8	1032.0
1/2	10.99	9.621	3/8	45.16	162.29	3/8	79.71	505.71	3/8	114.2	1039.1
5/8	11.38	10.320	1/2	45.55	165.13	1/2	80.10	510.70	1/2	114.6	1049.3
3/4	11.78	11.044	5/8	45.94	167.98	5/8	80.50	515.72	5/8	115.0	1053.5
7/8	12.17	11.793	3/4	46.33	170.87	3/4	80.89	520.70	3/4	115.4	1060.7
			7/8	46.73	173.78	7/8	81.28	525.83	7/8	115.8	1067.9
4	12.65	12.566									
1/8	12.95	13.364	15	47.12	176.71	26	81.68	530.93	37	116.2	1075.2
1/4	13.35	14.186	1/8	47.51	179.67	1/8	82.07	536.04	1/8	116.6	1082.4
3/8	13.74	15.033	1/4	47.90	182.72	1/4	82.46	541.18	1/4	117.0	1089.7
1/2	14.13	15.904	3/8	48.30	185.66	3/8	82.85	546.35	3/8	117.4	1097.1
5/8	14.52	16.800	1/2	48.69	188.69	1/2	83.25	551.54	1/2	117.8	1104.4
3/4	14.92	17.720	5/8	49.08	191.74	5/8	83.64	556.76	5/8	118.2	1111.8
7/8	15.31	18.665	3/4	49.48	194.82	3/4	84.03	562.00	3/4	118.6	1119.2
			7/8	49.87	197.73	7/8	84.43	567.26	7/8	118.9	1126.6
5	15.70	19.635	16	50.26	201.06	27	84.82	572.55	38	119.3	1134.1
1/8	16.10	20.629	1/8	50.65	204.21	1/8	85.21	577.87	1/8	119.7	1141.5
1/4	16.49	21.647	1/4	51.05	207.39	1/4	85.60	583.20	1/4	120.1	1149.0
3/8	16.88	22.690	3/8	51.44	210.59	3/8	86.00	588.57	3/8	120.5	1156.6
1/2	17.27	23.758	1/2	51.83	213.82	1/2	86.39	593.95	1/2	120.9	1164.1
5/8	17.67	24.850	5/8	52.22	217.07	5/8	86.78	599.37	5/8	121.3	1171.7
3/4	18.06	25.967	3/4	52.62	220.35	3/4	87.17	604.80	3/4	121.7	1179.3
7/8	18.45	27.108	7/8	53.01	223.65	7/8	87.57	610.26	7/8	122.1	1186.9
6	18.84	28.274	17	53.40	226.98	28	87.96	615.75	39	122.5	1194.5
1/8	19.24	29.464	1/8	53.79	230.33	1/8	88.35	621.26	1/8	122.9	1202.2
1/4	19.63	30.679	1/4	54.19	233.70	1/4	88.75	626.79	1/4	123.3	1209.9
3/8	20.02	31.919	3/8	54.58	237.10	3/8	89.14	632.35	3/8	123.7	1217.6
1/2	20.42	33.183	1/2	54.97	240.52	1/2	89.53	637.94	1/2	124.0	1225.4
5/8	20.81	34.471	5/8	55.37	243.97	5/8	89.92	643.54	5/8	124.4	1233.1
3/4	21.20	35.784	3/4	55.76	247.45	3/4	90.32	649.18	3/4	124.8	1240.9
7/8	21.57	37.122	7/8	56.16	250.94	7/8	90.71	654.83	7/8	125.2	1248.7
7	21.90	38.484	18	56.54	254.46	29	91.10	660.52	40	125.6	1256.6
1/8	22.38	39.871	1/8	56.94	258.01	1/8	91.49	666.22	1/8	126.0	1264.5
1/4	22.77	41.282	1/4	57.33	261.58	1/4	91.89	671.95	1/4	126.4	1272.3
3/8	23.16	42.718	3/8	57.72	265.18	3/8	92.28	677.71	3/8	126.8	1280.3
1/2	23.56	44.178	1/2	58.11	268.80	1/2	92.67	683.49	1/2	127.2	1288.2
5/8	23.95	45.663	5/8	58.51	272.44	5/8	93.06	689.29	5/8	127.6	1291.2
3/4	24.34	47.173	3/4	58.90	276.11	3/4	93.46	695.12	3/4	128.0	1304.2
7/8	24.74	48.707	7/8	59.29	279.81	7/8	93.85	700.98	7/8	128.4	1312.2
8	25.13	50.265	19	59.69	283.52	30	94.24	706.86	41	128.8	1320.2
1/8	25.52	51.848	1/8	60.08	287.27	1/8	94.64	712.76	1/8	129.1	1328.3
1/4	25.91	53.456	1/4	60.47	291.03	1/4	95.03	718.69	1/4	129.5	1336.4
3/8	26.31	55.088	3/8	60.86	294.83	3/8	95.42	724.64	3/8	129.9	1344.5
1/2	26.70	56.745	1/2	61.26	298.64	1/2	95.81	730.61	1/2	130.3	1352.6
5/8	27.09	58.426	5/8	61.65	302.48	5/8	96.21	736.61	5/8	130.7	1360.8
3/4	27.47	60.132	3/4	62.04	306.35	3/4	96.60	742.64	3/4	131.1	1369.0
7/8	27.88	61.862	7/8	62.43	310.24	7/8	93.85	700.98	7/8	131.5	1377.2
9	28.27	63.617	20	62.83	314.16	31	97.38	754.76	42	131.9	1385.4
1/8	28.66	65.396	1/8	63.22	318.09	1/8	97.78	760.86	1/8	132.3	1393.7
1/4	29.05	67.200	1/4	63.61	322.06	1/4	98.17	766.99	1/4	132.7	1401.9
3/8	29.45	69.029	3/8	64.01	326.05	3/8	98.56	773.14	3/8	133.1	1410.2
1/2	29.84	70.882	1/2	64.40	330.06	1/2	98.96	779.31	1/2	133.5	1418.3
5/8	30.23	72.759	5/8	64.79	334.10	5/8	99.35	785.51	5/8	133.9	1420.9
3/4	30.63	74.662	3/4	65.18	338.16	3/4	99.74	791.73	3/4	134.3	1435.3
7/8	31.02	76.588	7/8	65.58	342.25	7/8	100.1	797.97	7/8	134.6	1443.7

Printed in U. S. A. 11-38

EHRET
INSULATIONS

Circumferences and Areas of Circles

Diam.	Circ.	Area	Diam.	Circ.	Area	Diam.	Circ.	Area	Diam.	Circ.	Area
43	135.0	1452.2	54	169.6	2290.2	65	204.2	3318.3	78	245.0	4778.3
1/8	135.4	1460.6	1/8	170.0	2300.8	1/8	204.5	3331.0	1/4	245.8	4809.0
1/4	135.8	1469.1	1/4	170.4	2311.4	1/4	204.9	3343.8	1/2	246.6	4839.8
3/8	136.2	1477.6	3/8	170.8	2322.1	3/8	205.3	3356.7	3/4	247.4	4870.7
1/2	136.6	1486.1	1/2	171.2	2332.8	1/2	205.7	3369.5	79	248.1	4901.6
5/8	137.0	1494.7	5/8	171.6	2343.5	5/8	206.1	3382.4	1/4	248.9	4932.7
3/4	137.4	1503.3	3/4	172.0	2354.2	3/4	206.5	3395.3	1/2	249.7	4963.9
7/8	137.8	1511.9	7/8	172.3	2365.0	7/8	206.9	3408.2	3/4	250.5	4995.1
44	138.2	1520.5	55	172.7	2375.8	66	207.3	3421.2	80	251.3	5026.5
1/8	138.6	1529.1	1/8	173.1	2386.6	1/8	207.7	3434.1	1/4	252.1	5058.0
1/4	139.0	1537.8	1/4	173.5	2397.4	1/4	208.1	3447.1	1/2	252.8	5089.5
3/8	139.4	1546.5	3/8	173.9	2408.3	3/8	208.5	3460.1	3/4	253.6	5121.2
1/2	139.8	1555.2	1/2	174.3	2419.2	1/2	208.9	3473.2	81	254.4	5153.0
5/8	140.1	1564.0	5/8	174.7	2430.1	5/8	209.3	3486.3	1/4	255.2	5184.8
3/4	140.5	1572.8	3/4	175.1	2441.0	3/4	209.7	3499.3	1/2	256.0	5216.8
7/8	140.9	1581.6	7/8	175.5	2452.0	7/8	210.0	3512.5	3/4	256.8	5248.8
45	141.3	1590.4	56	175.9	2463.0	67	210.4	3525.6	82	257.6	5281.0
1/8	141.7	1599.2	1/8	176.3	2474.0	1/8	210.9	3538.8	1/4	258.3	5313.2
1/4	142.1	1608.1	1/4	176.7	2485.0	1/4	211.2	3552.0	1/2	259.1	5345.6
3/8	142.5	1617.0	3/8	177.1	2496.1	3/8	211.6	3565.2	3/4	259.9	5378.0
1/2	142.9	1625.9	1/2	177.5	2507.1	1/2	212.0	3578.4	83	260.7	5410.6
5/8	143.3	1634.9	5/8	177.8	2518.2	5/8	212.4	3591.7	1/4	261.5	5443.2
3/4	143.7	1643.8	3/4	178.2	2529.4	3/4	212.8	3605.0	1/2	262.3	5476.0
7/8	144.1	1652.8	7/8	178.6	2540.5	7/8	213.2	3618.3	3/4	263.1	5508.8
46	144.5	1661.9	57	179.0	2551.7	68	213.6	3631.6	84	263.8	5541.7
1/8	144.9	1670.9	1/8	179.4	2562.9	1/8	214.0	3645.0	1/4	264.6	5574.8
1/4	145.2	1680.0	1/4	179.8	2574.1	1/4	214.4	3658.4	1/2	265.4	5607.9
3/8	145.6	1689.1	3/8	180.2	2585.4	3/8	214.8	3671.8	3/4	266.2	5641.1
1/2	146.0	1698.2	1/2	180.6	2596.7	1/2	215.1	3685.2	85	267.0	5674.5
5/8	146.4	1707.3	5/8	181.0	2608.0	5/8	215.5	3698.7	1/4	267.8	5707.9
3/4	146.8	1716.5	3/4	181.4	2619.3	3/4	215.9	3712.2	1/2	268.6	5741.4
7/8	147.2	1725.7	7/8	181.8	2630.7	7/8	216.3	3725.7	3/4	269.3	5775.0
47	147.6	1734.9	58	182.2	2642.0	69	216.7	3739.2	86	270.1	5808.8
1/8	148.0	1744.1	1/8	182.6	2653.4	1/8	217.1	3752.8	1/4	270.9	5842.6
1/4	148.4	1753.4	1/4	182.9	2664.9	1/4	217.5	3766.4	1/2	271.7	5876.5
3/8	148.8	1762.7	3/8	183.3	2676.3	3/8	217.9	3780.0	3/4	272.5	5910.5
1/2	149.2	1772.0	1/2	183.7	2687.8	1/2	218.3	3793.6	87	273.3	5944.6
5/8	149.6	1781.3	5/8	184.1	2690.3	5/8	218.7	3807.3	1/4	274.1	5978.9
3/4	150.0	1790.7	3/4	184.5	2710.8	3/4	219.1	3821.0	1/2	274.8	6013.2
7/8	150.4	1800.1	7/8	184.9	2722.4	7/8	219.5	3834.7	3/4	275.6	6047.6
48	150.7	1809.5	59	185.3	2733.9	70	219.9	3848.4	88	276.4	6082.1
1/8	151.1	1818.9	1/8	185.7	2745.5	1/8	220.3	3862.2	1/4	277.2	6116.7
1/4	151.5	1828.4	1/4	186.1	2757.1	1/4	220.6	3875.9	1/2	278.0	6151.4
3/8	151.9	1837.9	3/8	186.5	2768.8	3/8	221.0	3889.8	3/4	278.8	6186.2
1/2	152.3	1847.4	1/2	186.9	2780.5	1/2	221.4	3903.6	89	279.6	6221.1
5/8	152.7	1856.9	5/8	187.3	2792.2	5/8	221.8	3917.4	1/4	280.3	6256.1
3/4	153.1	1866.5	3/4	187.7	2803.9	3/4	222.2	3931.3	1/2	281.1	6291.2
7/8	153.5	1876.1	7/8	188.1	2815.6	7/8	222.6	3945.2	3/4	281.9	6326.4
49	153.9	1885.7	60	188.4	2827.4	71	223.0	3959.2	90	282.7	6361.7
1/8	154.3	1895.3	1/8	188.8	2839.2	1/8	223.4	3973.1	1/4	283.5	6397.1
1/4	154.7	1905.0	1/4	189.2	2851.0	1/4	223.8	3987.1	1/2	284.3	6432.6
3/8	155.1	1914.7	3/8	189.6	2862.8	3/8	224.2	4001.1	3/4	285.1	6468.2
1/2	155.5	1924.4	1/2	190.0	2874.7	1/2	224.6	4015.1	91	285.8	6503.8
5/8	155.9	1934.1	5/8	190.4	2886.6	5/8	225.0	4029.2	1/4	286.6	6539.6
3/4	156.2	1943.9	3/4	190.8	2898.5	3/4	225.4	4043.2	1/2	287.4	6575.5
7/8	156.6	1953.6	7/8	191.2	2910.5	7/8	225.8	4067.3	3/4	288.2	6611.5
50	157.0	1963.5	61	191.6	2922.4	72	226.1	4071.5	92	289.0	6647.6
1/8	157.4	1973.3	1/8	192.0	2934.4	1/8	226.5	4085.6	1/4	289.8	6683.8
1/4	157.8	1983.1	1/4	192.4	2946.4	1/4	226.9	4099.8	1/2	290.5	6720.0
3/8	158.2	1993.0	3/8	192.8	2958.5	3/8	227.3	4114.0	3/4	291.3	6756.4
1/2	158.6	2002.9	1/2	193.2	2970.5	1/2	227.7	4128.2	93	292.1	6792.0
5/8	159.0	2012.8	5/8	193.6	2982.6	5/8	228.1	4142.5	1/4	292.9	6829.4
3/4	159.4	2022.8	3/4	193.9	2994.6	3/4	228.5	4156.7	1/2	293.7	6866.1
7/8	159.8	2032.8	7/8	194.3	3006.9	7/8	228.9	4171.0	3/4	294.5	6902.9
51	160.2	2042.8	62	194.7	3019.0	73	229.3	4185.3	94	295.3	6939.7
1/8	160.6	2052.8	1/8	195.1	3031.2	1/8	229.7	4199.7	1/4	296.0	6976.7
1/4	161.0	2062.9	1/4	195.5	3043.4	1/4	230.1	4214.1	1/2	296.8	7013.8
3/8	161.3	2072.9	3/8	195.9	3055.7	3/8	230.5	4228.5	3/4	297.6	7050.9
1/2	161.7	2083.0	1/2	196.3	3067.9	1/2	230.9	4242.9	95	298.4	7088.2
5/8	162.1	2093.2	5/8	196.7	3080.2	5/8	231.3	4257.3	1/4	299.2	7125.5
3/4	162.5	2103.3	3/4	197.1	3092.5	3/4	231.6	4271.8	1/2	300.0	7163.0
7/8	162.9	2113.5	7/8	197.5	3104.8	7/8	232.0	4286.3	3/4	300.8	7200.5
52	163.3	2123.7	63	197.9	3117.2	74	232.4	4300.8	96	301.5	7238.2
1/8	163.7	2133.9	1/8	198.3	3129.6	1/8	232.8	4315.3	1/4	302.3	7275.9
1/4	164.1	2144.1	1/4	198.7	3142.0	1/4	233.2	4329.9	1/2	303.1	7313.8
3/8	164.5	2154.4	3/8	199.0	3144.4	3/8	233.6	4344.5	3/4	303.9	7341.7
1/2	164.9	2164.7	1/2	199.4	3166.9	1/2	234.0	4359.1	97	304.7	7389.8
5/8	165.3	2175.0	5/8	199.8	3179.4	5/8	234.4	4373.8	1/4	305.5	7427.9
3/4	165.7	2185.4	3/4	200.2	3191.9	3/4	234.8	4388.4	1/2	306.3	7466.2
7/8	166.1	2195.7	7/8	200.6	3204.4	7/8	235.2	4403.1	3/4	307.0	7504.4
53	166.5	2206.1	64	201.0	3216.9	75	235.6	4417.8	98	307.8	7542.9
1/8	166.8	2216.6	1/8	201.4	3229.5	1/4	236.4	4447.3	1/4	308.6	7581.5
1/4	167.2	2227.0	1/4	201.8	3242.1	1/2	237.1	4476.9	1/2	309.4	7620.1
3/8	167.6	2237.5	3/8	202.2	3254.8	3/4	237.9	4506.6	3/4	310.2	7658.8
1/2	168.0	2248.0	1/2	202.6	3267.4	76	238.7	4536.4	99	311.0	7697.7
5/8	168.4	2258.5	5/8	203.0	3280.1	1/4	239.5	4566.3	1/4	311.8	7736.6
3/4	168.8	2269.0	3/4	203.4	3292.8	1/2	240.3	4596.3	1/2	312.5	7775.6
7/8	169.2	2279.6	7/8	203.8	3305.5	3/4	241.1	4626.4	3/4	313.3	7814.7
						77	241.9	4566.6	100	314.1	7853.0
						1/4	242.6	4686.9	1/4	314.9	7893.3
						1/2	243.4	4717.3	1/2	315.7	7932.7
						3/4	244.2	4747.7	3/4	316.4	7972.2

SOME PROPERTIES OF LIQUIDS

Liquid	Weight, in Pounds		Boiling Point Degrees F.	Freezing or Congealing Point Degrees F.	Latent Heat of Evap. BTUs	Specific Heat BTUs per Pound per Degree F.
	Per Gal.	Per Cu. Ft.				
Alcohol (Ethyl)	.....	50	172.4	— 148	369	0.648
Benzene	7.35	.....	176.3	+ 5 to + 20	169.4	0.423
Fuel Oil (Bunker C)	8.0 to 8.3	.....	.....	.....	145 to 150	0.500
Gasoline	6.5	.....	158 to 194	— 75	128 to 146	0.660 to 0.690
Kerosene	6.9	.....	.....	.....	108	0.470
Mercury	.....	849	674.6	— 39	117	0.033
Molasses	.....	87.4	.....	.....	.....	0.600
Naphtha	5.5	.....	306	.....	184	0.493
Water (Fresh)	.....	62.4	212	+ 32	970	1.000
Water (Sea)	.....	64.08	213.2	+ 27	.....	.....

SQUARE FEET OF RADIATING SURFACE

For Various Lengths of Pipe, Per Lineal Foot

(On all lengths over one foot, figures are given to nearest tenth.)

Length of Pipe in ft.	SIZE OF PIPE, IN INCHES										
	¾	1	1¼	1½	2	2½	3	3½	4	5	6
1	.275	.346	.434	.494	.622	.753	.916	1.047	1.175	1.455	1.739
2	.5	.7	.9	1.0	1.2	1.5	1.8	2.1	2.4	2.9	3.5
3	.8	1.0	1.3	1.5	1.9	2.3	2.7	3.1	3.5	4.4	5.2
4	1.1	1.4	1.7	2.0	2.5	3.0	3.6	4.2	4.7	5.8	7.0
5	1.4	1.7	2.2	2.4	3.1	3.8	4.6	5.2	5.8	7.3	7.7
6	1.6	2.1	2.6	2.9	3.7	4.5	5.5	6.3	7.0	8.7	10.5
7	1.9	2.4	3.0	3.4	4.4	5.3	6.4	7.3	8.2	10.2	12.1
8	2.2	2.8	3.5	3.9	5.0	6.0	7.3	8.4	9.4	11.6	13.9
9	2.5	3.1	3.9	4.4	5.6	6.8	8.2	9.4	10.6	13.1	15.7
10	2.7	3.5	4.3	4.9	6.2	7.5	9.1	10.5	11.8	14.6	17.4
11	3.0	3.8	4.8	5.4	6.8	8.3	10.0	11.5	12.9	16.0	19.1
12	3.3	4.1	5.2	5.9	7.5	9.0	11.0	12.6	14.1	17.4	20.9
13	3.6	4.5	5.6	6.4	8.1	9.8	11.9	13.6	15.3	18.9	22.6
14	3.8	4.8	6.1	6.9	8.7	10.5	12.8	14.7	16.5	20.3	24.3
15	4.1	5.2	6.5	7.4	9.3	11.3	13.7	15.7	17.6	21.8	26.1
16	4.4	5.5	6.9	7.9	10.0	12.0	14.6	16.7	18.8	23.2	27.8
17	4.7	5.9	7.4	8.4	10.6	12.8	15.5	17.8	20.0	24.7	29.5
18	5.0	6.2	7.8	8.9	11.2	13.5	16.5	18.8	21.2	26.2	31.3
19	5.2	6.6	8.3	9.4	11.8	14.3	17.4	19.9	22.3	27.6	33.1
20	5.5	6.9	8.7	9.9	12.5	15.0	18.3	20.9	23.5	29.1	34.8
25	6.9	8.6	10.9	12.3	15.6	18.8	22.9	26.2	29.3	36.3	43.5
30	8.3	10.4	13.0	14.8	18.7	22.5	27.5	31.4	35.3	43.6	52.1
35	9.6	12.1	15.2	17.3	21.8	26.3	32.0	36.6	41.1	50.9	60.8
40	11.0	13.8	17.4	19.8	24.9	30.1	36.6	41.9	47.0	58.2	69.5
45	12.4	15.6	19.5	22.2	28.0	33.8	41.2	47.1	52.9	65.5	78.2
50	13.8	17.3	21.7	24.7	31.1	37.6	45.8	52.3	58.7	72.7	87.0
55	15.2	19.0	23.9	27.1	34.3	41.3	50.4	57.6	64.6	80.1	95.6
60	16.6	20.8	26.0	29.6	37.3	45.2	55.0	62.8	70.5	87.3	104.3
65	18.0	22.6	28.2	32.1	40.5	48.8	59.5	68.0	76.4	94.5	112.9
70	19.4	24.2	30.4	34.6	43.5	52.7	64.1	73.3	82.3	101.9	121.7
75	20.7	26.0	32.6	37.1	46.6	56.5	68.7	78.5	88.1	109.1	130.4
80	22.0	27.7	34.7	39.6	49.8	60.2	73.3	83.8	94.0	116.4	139.1
85	23.4	29.4	36.9	42.0	53.4	63.9	77.8	89.0	99.9	123.7	147.9
90	24.8	31.1	39.1	44.5	56.0	67.8	82.4	94.2	105.8	130.9	156.5
95	26.2	32.9	41.2	46.9	59.6	71.5	87.2	99.5	111.6	138.2	165.2
100	27.5	34.6	43.4	49.4	62.2	75.3	91.6	104.7	117.5	145.5	173.9

Printed in U. S. A. 1-39

EHRET INSULATIONS

TOTAL RADIATING AREA OF FLANGED FITTINGS

(including accompanying flanges)

In square feet and in equivalent length of same size pipe

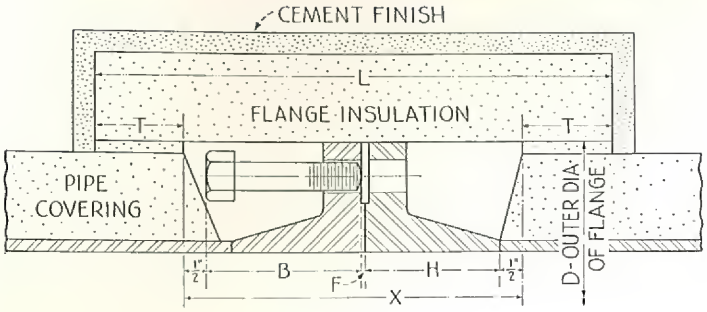
STANDARD WEIGHT FITTINGS

Pipe Size in Inches	Flanged Couplings		90° Ells		Long Radius Ells		Tees		Crosses	
	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.
1	.32	.93	.79	2.31	.89	2.59	1.24	3.59	1.62	4.72
1¼	.38	.88	.96	2.20	1.08	2.49	1.48	3.40	1.94	4.47
1½	.48	.95	1.17	2.35	1.34	2.68	1.82	3.64	2.38	4.78
2	.67	1.08	1.65	2.65	1.84	2.96	2.54	4.08	3.32	5.34
2½	.84	1.12	2.09	2.78	2.32	3.08	3.21	4.26	4.19	5.56
3	.95	1.03	2.38	2.60	2.68	2.93	3.66	3.99	4.77	5.70
3½	1.12	1.07	2.98	2.85	3.28	3.13	4.48	4.28	5.83	5.56
4	1.34	1.14	3.53	2.90	3.96	3.36	5.41	4.59	7.03	5.97
4½	1.47	1.13	3.95	3.01	4.43	3.38	6.07	4.63	7.87	6.01
5	1.62	1.11	4.44	3.05	5.00	3.43	6.81	4.67	8.82	6.06
6	1.82	1.05	5.13	2.95	5.99	3.45	7.84	4.53	10.08	5.81
7	2.17	1.05	6.17	3.09	7.38	3.70	9.37	4.69	12.00	6.01
8	2.41	1.07	6.98	3.09	8.56	3.79	10.55	4.67	13.44	5.96
9	3.00	1.19	8.71	3.46	10.57	4.20	13.18	5.23	16.78	6.66
10	3.43	1.22	10.18	3.61	12.35	4.38	15.41	5.47	19.58	6.95
12	4.41	1.32	13.08	3.92	16.35	4.90	19.67	5.89	24.87	7.45
14	5.39	1.47	16.38	4.47	20.17	5.47	24.81	6.78	31.48	8.60
16	6.69	1.60	20.17	4.82	25.41	6.07	30.32	7.23	38.34	9.15

EXTRA HEAVY FITTINGS

Pipe Size in Inches	Flanged Couplings		90° Ells		Long Radius Ells		Tees		Crosses	
	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.	Area in Sq. Ft.	Pipe Length in Ft.
1	.44	1.27	1.02	2.95	1.08	3.15	1.58	4.58	2.07	6.02
1¼	.51	1.17	1.10	2.52	1.34	3.08	1.93	4.43	2.53	5.82
1½	.73	1.46	1.33	2.67	1.87	3.76	2.68	5.38	3.54	7.11
2	.85	1.36	2.01	3.23	2.16	3.47	3.09	4.97	4.06	6.53
2½	1.11	1.46	2.57	3.41	2.76	3.67	4.05	5.38	5.17	6.87
3	1.48	1.62	3.49	3.81	3.74	4.08	5.33	5.82	6.95	7.58
3½	1.64	1.57	3.96	3.78	4.28	4.09	6.04	5.77	7.89	7.54
4	1.91	1.62	4.64	3.94	4.99	4.24	7.07	6.00	9.24	7.84
4½	2.04	1.56	5.02	3.83	5.46	4.17	7.72	5.90	10.07	7.69
5	2.18	1.50	5.47	3.76	6.02	4.13	8.52	5.85	10.97	7.53
6	2.78	1.60	6.99	4.03	7.76	4.48	10.64	6.14	13.75	7.93
7	3.46	1.73	8.62	4.32	9.73	4.87	12.33	6.18	16.83	8.43
8	3.77	1.67	9.76	4.32	11.09	4.91	14.74	6.53	18.97	8.41
9	4.44	1.76	11.44	4.54	13.17	5.23	17.23	6.84	22.10	8.77
10	5.20	1.85	13.58	4.82	15.60	5.54	20.41	7.25	26.26	9.32
12	6.71	2.01	17.73	5.31	18.76	5.62	26.65	7.99	34.11	10.22
14	8.30	2.26	22.31	6.08	25.70	7.02	33.63	9.18	43.15	11.75
16	10.05	2.40	27.18	6.48	31.73	7.58	40.94	9.78	52.35	12.50

Dimensions for Molded Insulation Over Flanges



L = X + 2T (these tables based on T equaling 2″).

T is recommended to be no less than 2″ but should be about equal to the thickness of the covering on the pipe when the covering thickness is greater than 2″.

H (hub length) is based on welding neck flanges.

Where the outer diameter of the flange permits, pieces of sectional or segmental pipe covering may be used instead of narrow blocks. In such cases the length (L) might be altered a reasonable amount to agree with even divisions of the standard 36″ long sections.

Pipe Size inches	150 lb. Fittings			300 lb. Fittings			400 lb. Fittings			600 lb. Fittings			900 lb. Fittings			1500 lb. Fittings		
	D	X	L	D	X	L	D	X	L	D	X	L	D	X	L	D	X	L
½	3½	5 3/16	9 3/16	3¾	5⅝	9⅝	3¾	6 9/16	10 9/16	3¾	6 9/16	10 9/16	4¾	8⅛	12⅛	4¾	8⅛	12⅛
¾	3⅞	5⅜	9⅜	4⅝	6 5/16	10 5/16	4⅝	7¼	11¼	4⅝	7¼	11¼	5⅛	8¾	12¾	5⅛	8¾	12¾
1	4¼	5½	9½	4⅞	6½	10½	4⅞	7 7/16	11 7/16	4⅞	7 7/16	11 7/16	5⅞	9⅜	13⅜	5⅞	9⅜	13⅜
1¼	4⅝	5 13/16	9 13/16	5¼	6¾	10¾	5¼	7⅞	11⅞	5¼	7⅞	11⅞	6¼	9⅜	13⅜	6¼	9⅜	13⅜
1½	5	6¼	10¼	6⅛	7¼	11¼	6⅛	8½	12½	6⅛	8½	12½	7	10¼	14¼	7	10¼	14¼
2	6	6 13/16	10 13/16	6½	7½	11½	6½	8⅝	12⅝	6½	8⅝	12⅝	8½	11¼	15¼	8½	11¼	15¼
2½	7	7 5/16	11 5/16	7½	8 1/16	12 1/16	7½	9⅜	13⅜	7½	9⅜	13⅜	9⅝	11⅞	15⅞	9⅝	11⅞	15⅞
3	7½	7 5/16	11 5/16	8¼	8 7/16	12 7/16	8¼	9¾	13¾	8¼	9¾	13¾	9½	11¼	15¼	10½	13⅛	17⅛
3½	8½	7⅜	11⅜	9	8½	12½	9	10⅜	14⅜	9	10⅜	14⅜	.....	.....	.....	.....	.....	.....
4	9	7 9/16	11 9/16	10	8 15/16	12 15/16	10	10½	14½	10¾	11¼	15¼	11½	12¾	16¾	12¼	14⅛	18⅛
5	10	8 5/16	12 5/16	11	9 11/16	13 11/16	11	11¼	15¼	13	12½	16½	13¾	14	18	14¾	17⅜	21⅜
6	11	8 9/16	12 9/16	12½	9 11/16	13 11/16	12½	11 9/16	15 9/16	14	12⅞	16⅞	15	14¼	18¼	15½	19	23
8	13½	9 5/16	13 5/16	15	10 15/16	14 15/16	15	11⅞	15⅞	16½	14½	18½	18½	16⅝	20⅝	19	21⅜	25⅜
10	16	9 13/16	13 13/16	17½	11 15/16	15 15/16	17½	13⅞	17⅞	20	16	20	21½	18	22	23	25	29
12	19	10 5/16	14 5/16	20½	12 15/16	16 15/16	20½	14⅞	18⅞	22	16⅜	20⅜	24	19⅜	23⅜	26½	27⅝	31⅝
14 (O. D.)	21	11 5/16	15 5/16	23	13 7/16	17 7/16	23	15⅝	19⅝	23¾	17¼	21¼	25¼	20⅝	24⅝	29½	29½	33½
16 "	23½	11 9/16	15 9/16	25½	14 5/16	18 5/16	25½	16¼	20¼	27	18½	22½	27¾	21¼	25¼	32½	31½	35½
18 "	25	12 9/16	16 9/16	28	15 1/16	19 1/16	28	17	21	29¼	19½	23½	31	23½	27½	36	33⅞	37⅞
20 "	27½	13¼	17½	30½	15 11/16	19 11/16	30½	17⅞	21⅞	32	20½	24½	33¾	25	29	38¾	37	41
24 "	32	14 1/16	18 1/16	36	16 15/16	20 15/16	36	19⅛	23⅛	37	21½	25½	41	30¼	34¼	46	41¾	45¾

EHRET INSULATIONS

Thermal Properties of Flue Gases

Temp. in Deg. F.	Mean Specific Heat (from 60° to Temperature shown) in BTUs per Cu. Ft. per Deg. F.				Heat Content above 60° F. in BTUs per Cu. Ft.			
	Carbon Dioxide	Water Vapor	Nitrogen, Oxygen, Air, Carbon Monoxide	Hydrogen	Carbon Dioxide	Water Vapor	Nitrogen, Oxygen, Air, Carbon Monoxide	Hydrogen
200	0.0248	0.0221	0.0185	0.0183	3.5	3.0	2.5	2.5
400	0.0255	0.0223	0.0186	0.0184	8.7	7.6	6.3	6.3
600	0.0262	0.0225	0.0187	0.0185	14.2	12.2	10.0	10.0
800	0.0268	0.0227	0.0188	0.0186	19.0	17.0	14.0	13.7
1000	0.0275	0.0230	0.0189	0.0187	26.0	21.6	17.9	17.5
1200	0.0281	0.0233	0.0190	0.0188	32.0	26.5	21.8	21.4
1400	0.0287	0.0237	0.0191	0.0189	38.5	31.8	25.7	25.2
1600	0.0293	0.0240	0.0192	0.0190	45.0	37.0	29.7	29.2
1800	0.0299	0.0244	0.0193	0.0191	52.0	42.5	33.8	33.2
2000	0.0304	0.0248	0.0195	0.0192	59.0	48.0	38.0	37.2
2200	0.0309	0.0252	0.0196	0.0193	66.2	54.0	42.1	41.2
2400	0.0314	0.0256	0.0197	0.0194	73.4	60.0	46.3	45.4
2600	0.0319	0.0261	0.0199	0.0195	81.0	66.2	50.5	49.5
2800	0.0324	0.0265	0.0200	0.0196	88.9	72.7	55.0	54.0
3000	0.0329	0.0270	0.0202	0.0197	96.4	79.2	59.3	58.0
3200	0.0333	0.0274	0.0203	0.0199	104.3	86.0	63.7	62.5
3400	0.0337	0.0279	0.0205	0.0201	112.5	93.0	68.3	67.0
3600	0.0341	0.0283	0.0206	0.0202	120.8	100.0	73.0	71.4
3800	0.0345	0.0287	0.0208	0.0203	129.0	107.2	77.5	75.8
4000	0.0349	0.0291	0.0209	0.0205	137.5	114.4	82.2	80.4

Ignition Temperatures

Substance	Degrees Fahr.	Substance	Degrees Fahr.
Sulphur	400 to 500	Methane	1200 to 1300
Hydrogen	1080 to 1140	Benzol	1350 to 1400
Fixed Carbon in Bituminous Coal	750 to 850	Acetylene	750 to 830
Fixed Carbon in Anthracite Coal	900 to 950	Propane	800 to 1000
Carbon Monoxide	1180 to 1220	Sugar	700 to 750
Crude Oil	150 to 600	Cylinder Oil	750 to 800
Kerosene	500 to 600	Gas Oil	300 to 350

Note:—The temperature given in the above table represents the average range of temperature in air at atmospheric pressure at which ignition actually occurs.

Thermal Resistance of Refractories

Expressed in BTUs per Hour per Sq. Ft. per Deg. F. per Inch Thickness

Refractory	Temperature—Deg. F.												
	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
Red Brick	6.2	6.5	7.0	7.4	7.8	8.3	8.7	....	....	....	....	....	....
Fire Clay Brick	6.5	6.8	7.3	7.7	8.2	8.6	9.1	9.5	10.0	10.4	10.9	11.4	11.7
Silica Brick	7.4	8.0	8.5	9.1	9.7	10.3	10.8	11.4	12.0	12.5	13.1	13.7	14.3
Alundum Brick	8.6	9.1	9.6	10.2	10.7	11.2	11.7	12.2	12.6	13.2	13.7	14.3	14.7
Chrome Brick	10.5	11.3	12.1	12.8	13.5	14.3	15.0	15.7	17.0	18.0	18.5	19.0	20.0
Magnesite Brick	23.0	25.0	27.0	29.5	32.0	34.0	36.0	38.0	41.0	43.5	45.5	47.5	50.5
Carborundum	60.0	62.5	64.0	65.0	67.0	70.0	72.0	74.0	75.5	78.0	80.0	83.0	85.0

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